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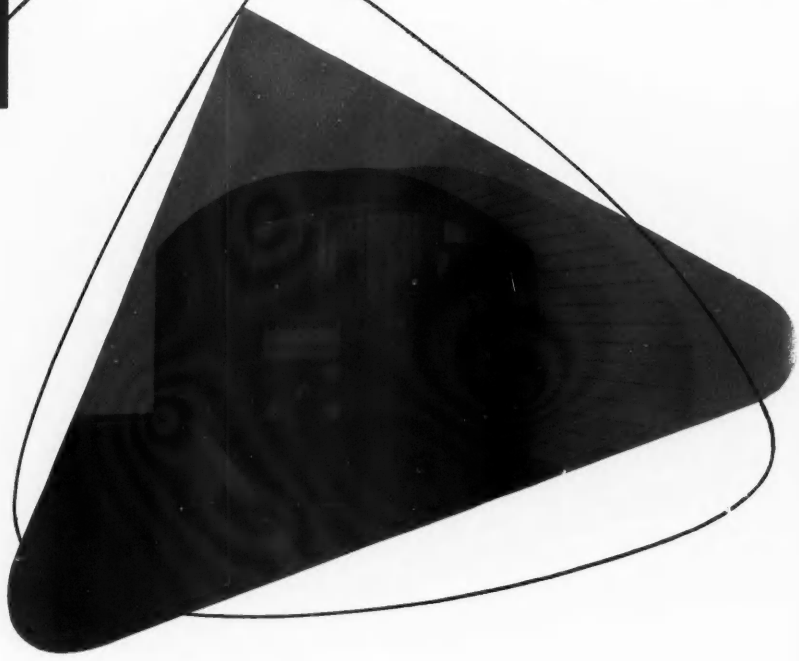

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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16 NOVEMBER 1956

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VOLUME 159 ✧ NUMBER 20

Eighty-Fifth Year of Publication

FRIDAY ✧ PRICE 1s 6d

117 *CLASSIFIED ADVERTISEMENTS*
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Editorial, Advertising and Publishing Offices : Dorset House, Stamford Street, London, S.E.1. Telegraphic Address : "Elecrev, Sedist, London." Code : ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription : Home and Overseas £4 10s 0d : U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

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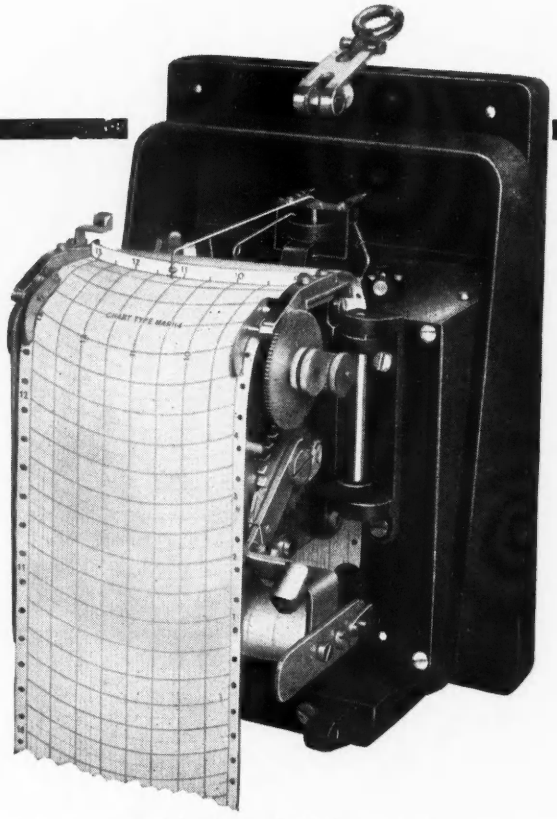

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ELECTRICAL REVIEW

16 November 1956 Vol. 159 No. 20 Established 1872

The Right Road?

AN outstanding development in large scale steam generating practice in Britain is being pioneered by the Steel Company of Wales and Simon-Carves, who have collaborated in a scheme incorporating the first Benson " Once Through " forced circulation boiler to be ordered in this country. The plant, which will be designed and built by Simon-Carves, is an extension to the " B " power station at Margam Steel Works in Wales, and will generate steam at the rate of 240,000 lb/hr at 3,300 lb/sq in and 1,060 deg F, with reheating to 840 deg F. These are, we think, the most advanced steam conditions ever used commercially in this country.

The modern Benson " Once Through " boiler has been developed from British designs patented by Mark Benson over 30 years ago. For steam generation at pressures near, at, or above the critical pressure it possesses many advantages in flexibility of operation and in speed and economy of construction and maintenance. Although it is of British origin, this type of forced circulation boiler has until recently been developed and established mainly in Germany, and its advantages are already widely accepted in Europe and in the United States.

It will be recalled that there was a good deal of discussion about the use of steam pressures up to the critical pressure at last year's British Electrical Power Convention at Brighton. Mr. Clinch, of the Eastern Electricity Board, spoke optimistically of obtaining thermal efficiencies above the 40 per cent mark by those means, although Mr. Eccles, whose paper Mr. Clinch was discussing, thought that this was rather too optimistic a figure.

We appear to have reached the stage when there are available alloy steels to stand up to these exceedingly high pressures and temperatures; but what of the capital cost? It is understood that these newer metals are very expensive and the question is raised in our mind whether the possible higher efficiency obtainable is worth the additional expenditure.

All these considerations have, of course, necessarily to be weighed against the trend in the development of the use of nuclear energy for raising steam for the production of electricity. So far we appear to have taken a retrograde step in steaming conditions in the nuclear field, because the pressures adopted at Calder Hall are those which were in use in this country, say, 40 years or so ago. But we can almost certainly say that we shall soon pass out of that phase and that very much higher pressures and temperatures will be used in connection with later nuclear generating stations. We do not suggest that nuclear power stations will soon use pressures of the order of the critical

pressure, but even so, if we can employ pressures in nuclear power stations more in line with modern practice the question arises whether we are on the right road in increasing the capital expenditure necessary to obtain the very much higher steam conditions in coal-fired power stations when conditions which are considered good at present are likely to prevail in nuclear energy stations.

NUCLEAR POWER PROGRESS

The Central Electricity Authority is now busy examining the tenders which have been submitted by the four industrial groups for the construction of Bradwell and Berkeley nuclear generating stations. The contracts are expected to be placed by the end of the year and work will begin on the sites shortly afterwards. Although these stations will be of the Calder Hall type, employing graphite moderated gas cooled thermal reactors, they will almost certainly represent a considerable advance in power reactor design. For one thing Calder Hall is primarily a plutonium production plant in which electricity is produced as a by-product.

In the C.E.A.'s nuclear power stations electricity generation will be the first consideration and because of this they can be expected to have a much higher output. Each station will have two reactors of roughly the same physical size as those at Calder Hall and these, in conjunction with a number of heat exchangers, will provide steam for at least double the amount of generating plant installed in Calder Hall. Thus we are likely to see nuclear stations with about six 60 MW or even four 100 MW sets with steam conditions approaching those employed at the beginning of the war. Rapid progress will undoubtedly be made, however, and before many years have elapsed we shall probably see nuclear power stations operating with high temperature and pressure steam.

WORKSHOP PRACTICE

In his chairman's address to the North Eastern Centre of the Institution of Electrical Engineers, reported in last week's issue, Mr. J. Christie deals with a vast number of everyday practices in the production workshops associated with the manufacture of switchgear which, he says, are little heard of nowadays in view of the many spectacular developments which are taking place.

We are very greatly impressed by the large number of extremely important practices which he mentions. These include shell moulding in the foundry; deep penetration welding; stud welding by a special gun; surface treatment; silver plating for contacts; holing and slotting control boards; replacing many types of insulating materials by new resins; new methods of transformer testing; new gases used for insulating and arc quenching in circuit-breakers; the degasifying of tungsten arc tips; the checking of bushings and insulators by immersing models in electrolytic tanks; and the use of "Perspex" for constructing experimental arc control devices. Mr. Christie says that all these taken separately may not appear important, but their overall effect is such that without them our country's products would not be competitive in the world's markets and they show that the British switchgear industry is making use of techniques representing the contributions of many individuals in many branches of science and industry.

"QUALIFIED" ENGINEERS

A report on the number and distribution of qualified scientists and engineers issued jointly by the Ministry of Labour and National Service and the Advisory Council on Scientific Policy was summarised in last week's issue (page 861). We do not quite agree with the definition of the term "qualified" as those possessing a university degree, corporate or graduate members of specified professional institutions or associates of educational institutions.

Surely a qualified engineer is one who can assume some degree of responsibility in the practical field which means the possession of a certain amount of practical experience. Although a university degree provides evidence of the desirable academic background to practical experience and responsibility, it does not ensure such experience and responsibility.

While on the whole we think that corporate membership of one of the professional institutions meets the term "qualified," because such membership calls for academic attainment, practical experience and some degree of responsibility, graduate membership is much less certain because practical experience and responsibility are called for to a lesser extent, if at all.

BRUSSELS EXHIBITION, 1958

We recently repeated an appeal of the British Electrical and Allied Manufacturers' Association for the support of the electrical industry for the great Brussels Exhibition to be held in 1958. We are now told that sufficient guarantees have been obtained to ensure a start on the British electrical exhibit, but to make it really worthy of the industry further support is sought. A total expenditure of about £125,000 is envisaged. It has been stressed that the Exhibition will not be a trade show and those participating must not expect their particular products to be labelled. The idea is to raise the standing of the British electrical industry in the eyes of the world—a very laudable and necessary object in view of the growing influence of competitors in world markets.

Although the B.E.A.M.A. is responsible for the electrical engineering section of the British Industrial Pavilion non-member firms and associations are invited to participate. Already some of the large electrical manufacturing associations have pledged their support and it is hoped that others will do so as soon as possible, remembering that the display is all-embracing. It is planned to link the exhibits closely to the home industry by arranging that trade visitors to the exhibition shall be brought over to Great Britain to see firms and works in which they are particularly interested. In this way it is hoped to secure tangible results from what is primarily a "prestige" display.

Junction Transistor Circuits

Survey of Current Design Techniques

By D. D. Jones, M.Sc., D.I.C.*

THE junction transistor has many features which make it an attractive circuit element for a number of applications. One of these, its ability to operate from a low voltage, has already led the hearing aid industry practically to abandon the miniature thermionic valve; in car radio receivers it removes the need for a vibrator pack. The transistor also holds the promise of long life and high reliability; this is particularly important in such fields as digital computers, industrial control, and telephony.

The device, however, has a number of limitations principally in the fields of high frequency and high power operation. Although it has been demonstrated that these can be overcome, it may take some time before this is achieved on a commercial scale. One finds, therefore, that much of the present circuit work involves operating transistors at frequencies and powers that are close to their performance limits. This type of work helps to reveal the nature of the limitations and thus provides information on which to base the design of improved transistors.

This article is principally concerned with both linear and non-linear circuits using the p-n-p type of transistors made from germanium. In common with all germanium devices the effect of temperature on the transistor characteristics, in particular on the collector cut-off current (I_{co}), has to be carefully considered in circuit design.

Linear Amplifiers

It is convenient to consider linear amplifiers under three main headings:—(*a*) small signal, low frequency, (*b*) large signal, low frequency, and (*c*) high frequency.

Small signal, low frequency amplifiers are widely used, for example, in the early amplifying stages of hearing aids. The transistor is usually operated in the common-emitter arrangement; this is analogous to the common-cathode thermionic valve circuit but there are a number of important differences. Thus the input resistance of the transistor amplifier is low (e.g. 1,000 ohms) and, due to internal feedback, depends on the resistance of the load.

Because of the interaction between input and output circuits arising from internal feedback, it has been found necessary to obtain equivalent networks to represent the transistor. Calculating the performance of a low frequency amplifier using such networks is not difficult particularly if certain valid approximations are made (e.g. it is often justifiable to ignore the load resistance when compared with the output resistance of the transistor).

Some typical values for such an amplifier are:—

Input resistance	~	1,000 ohms.
Output resistance	~	30,000 ohms.
Current amplification (α_{cb})	~	40 times.

Generator and load resistances are usually about 1,000 and 5,000 ohms respectively and power gains upwards of 1,000 times are readily realisable.

In order to obtain the maximum amount of power gain the generator and load resistance should match the input and output resistances respectively. Amplifiers are very often cascaded, in which case interstage transformers must be used in order to obtain maximum gain. Although a number of suitable transformers (step-down ratio of the order of 5 : 1) are marketed they are not extensively used because it is found that only a small reduction of gain is obtained when the stages are directly coupled via a resistor and capacitor arrangement.

It is necessary to pay considerable attention to the method of applying d.c. bias to this type of amplifier, particularly if it is required to operate over a range of ambient temperatures.

D.C. Bias Conditions

Bias is generally specified in terms of two parameters, namely emitter current (e.g. 1 mA) and collector voltage (e.g. −6 V). In most cases there is no significant difference in magnitude between emitter and collector currents. A single battery is generally used and it is necessary to devise bias circuits such that the bias conditions do not change significantly either with temperature or if one transistor is replaced by another.

Part of the bias current is generally due to the collector cut-off current, I_{co}; this is the current that flows between the collector and base electrodes when the emitter is open circuited. I_{co} is relatively independent of voltage and has a value of about 4 μA when the temperature of the collector junction is 20 deg C; it approximately doubles with every 10 deg C rise in this temperature.

To obtain suitable bias current a small negative direct current, I_b, is fed into the base electrode (e.g. from the collector supply voltage via a high resistor). It is found that the collector (or emitter) current that flows is given approximately by:—

$$I_c = \alpha_{cb} (I_{co} + I_b) \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where α_{cb} is the current multiplication factor mentioned earlier. If I_{co} is 4 μA, the component of I_c due to it is about 160 μA for a typical transistor. If the temperature of the collector junction (which may be significantly higher than the ambient temperature because of power being dissipated within the transistor) increases by 20 deg C this component of I_c will increase fourfold and will cause a substantial change in the value of I_c unless I_b is correspondingly reduced.

The circuit shown in Fig. 1 is a typical arrangement for obtaining bias current that is reasonably constant. It is achieved by placing a resistor in series with the emitter lead and connecting the base to a potential divider; this provides negative feedback and in order not to reduce the a.c. gain, as well as the d.c. gain, the resistor in series with the emitter is decoupled. A practical version of Fig. 1 might

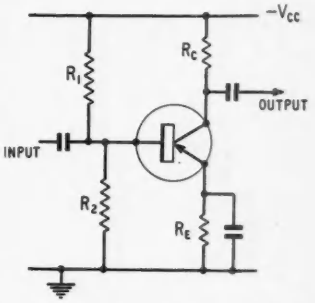
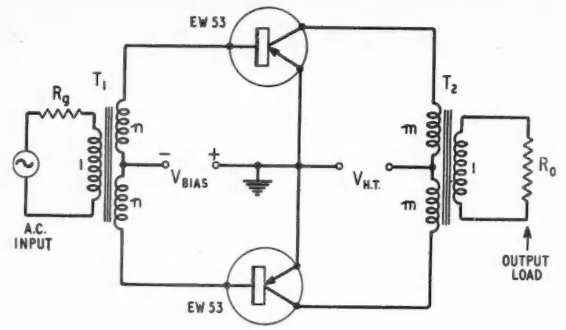
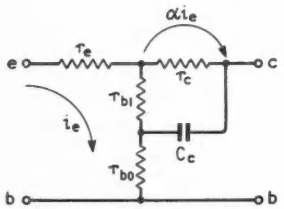


Fig. 1.—A common-emitter amplifier with d.c. bias stabilisation

* Research Laboratories, General Electric Co., Ltd.



Above: Fig. 2.—A common-emitter class B push-pull amplifier with small amount of "forward" bias



Left: Fig. 3.—Approximate equivalent circuit for alloy-type junction transistors

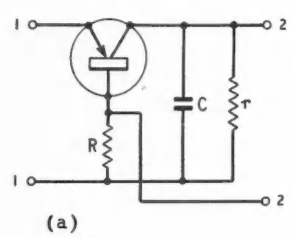
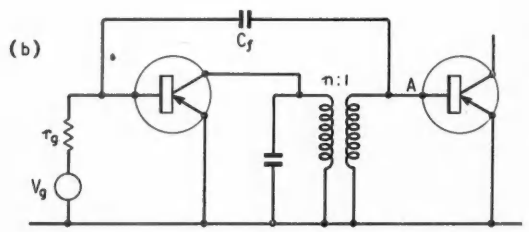


Fig. 4.—(a) Basic arrangement of bridge neutralisation. (b) Method of neutralisation used with the common-emitter amplifier



have values of 10 kΩ, 3 kΩ, 1 kΩ, and 5 kΩ, for R_1, R_2, R_E and R_C respectively. In this case the effective current gain at d.c. is reduced to about 4.

Of the two bias conditions mentioned above the emitter current is probably the more important for the following reasons:—(*a*) The input resistance increases rapidly with decrease of emitter current. (*b*) The current gain factor varies with emitter current. (*c*) The noise factor decreases with decrease of emitter current.

The common base amplifier is seldom used for low frequency work. The common collector arrangement (cf. cathode follower) is sometimes used where a high input resistance is required; values of up to a few hundred thousand ohms are possible. However, in a number of applications it has been found that an equally high input resistance can be obtained by operating the common emitter amplifier at low values of emitter current; in such a case it may be necessary to provide positive current into the base.

The manufacturer of transistors usually specifies a maximum value (P_c max) to the amount of power that can be dissipated at the collector. This may often be low and, in applications requiring substantial output power from an amplifier, it is therefore important to use a circuit that has the highest ratio between the output power and the dissipation that occurs within the transistor itself.

In a class A amplifier maximum dissipation occurs in the transistor when the a.c. input signal becomes zero. Since this condition usually has to be catered for, the maximum output power that can be obtained is $\frac{1}{2}$ P_c max; this assumes the maximum theoretical value operating efficiency of 50 per cent, a figure that may be closely approximated in junction transistor amplifiers.

In a class B amplifier, two of which must be arranged in a push-pull circuit in order to obtain similar input and output waveforms, almost zero dissipation occurs in the "zero input signal" condition. It has a maximum theoretical efficiency of 78·5 per cent and, using junction transistors, it is found that a.c. outputs of at least 2 P_c max are obtainable per transistor. Thus the class B amplifier has an advantage of at least four times over the class A amplifier and is widely used for this reason.

Two major forms of distortion occur in class B amplifiers. The first is known as "cross-over" distortion and gives rise to loss of intelligibility at low signal level. It occurs around the point where the polarity of the input signal changes sign. It is caused by the rapid increase in input resistance as the emitter current approaches zero. It can be overcome by (*a*) operating the amplifier from a high source resistance, and (*b*) biasing the transistor slightly forward, by d.c., as shown in Fig. 2. This means that the transistor is operated under slightly class A-B conditions. The second form of distortion arises because of the reduction of current gain at high values of emitter current. Because the maximum collector voltage that can be applied to a transistor is low, high emitter currents are necessary in order to obtain the required output power. The effect, which consists of "flattening" the peaks of the signal, can be minimised either by employing negative feedback in a common emitter circuit or by using a common collector circuit. Most transistors operate satisfactorily at frequencies up to about 10 kc/s in circuits of this type.

High Frequency Amplifiers

The highest frequency at which a junction transistor can be satisfactorily used is limited by a number of factors. These may best be seen by considering the equivalent network for a transistor in the common base connection as shown in Fig. 3. For a typical transistor (at $I_e = 1$ mA, $V_c = -6$ V) the values of r_e, r_{b1}, r_{bo}, and r_c are 25 Ω, 200 Ω, 50 Ω, and 2 MΩ respectively, whilst c_c may be as high as 60 pF; the value of the current gain factor α, is about 0·98; this is related to the common emitter current gain mentioned earlier by the expression:—

$$\alpha = \frac{\alpha_{cb}}{1 + \alpha_{cb}}$$

α is found to decrease with increasing frequency, an effect analogous to the transit time effect in a thermionic valve, and in the case of the transistors currently available commercially in this country it is found that its modulus is down to 0·7 of its low frequency value at a frequency of about 1 Mc/s (or less in some cases); the frequency at which this reduction occurs is called the alpha cut-off frequency, $f\alpha$. This reduction of current gain with frequency which has an associated phase change is one factor that limits the upper frequency of operation.

At frequencies of a few hundred kc/s the collector capacitance c_c effectively shunts r_c. It may then be seen from Fig. 3 that there is a feedback path provided by c_c and r_{bo}. This feedback increases with frequency as the impedance of c_c decreases. It is found that a figure of merit, Mg, can be defined which connects most of the frequency limiting parameters and which gives a useful

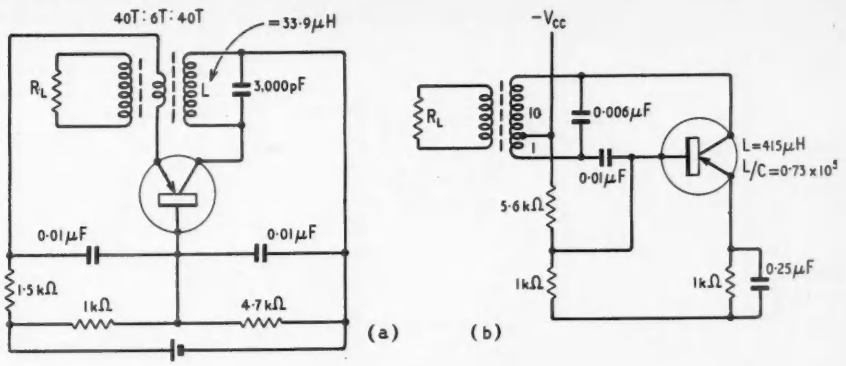


Fig. 5.—(a) Feedback oscillator, common-base arrangement and (b) Hartley oscillator

guide to the performance of a transistor in a high frequency amplifier.

$$Mg = \frac{f\alpha}{c_c\, r_{bo}},$$

where $f\alpha$ is the cut-off frequency in kc/s, c_c is the collector capacitance in $\mu\mu$F, and r_{bo} is in ohms. In practice it is found necessary to have a value of 2 or higher for Mg in order to obtain a power gain of 400 times in a narrow band amplifier at 500 kc/s.

Much attention is now being given to circuit techniques for reducing some of these effects. The circuits in Figs. 4 (*a*) and (*b*) show the type of neutralising techniques that are employed. In Fig. 4 (*a*) R and C are generally made equal to r_{bo} and c_c, giving rise to a balanced bridge arrangement in which the input signal is developed across two terminals and the output is taken from the other pair. In Fig. 4 (*b*) an output signal is fed back into the input and is out of phase with the signal fed back via the collector capacitance c_c. Improvements in high frequency performance will depend on manufacturers being able to make transistors having high $f\alpha$ accompanied by low c_c and r_{bo}.

Oscillator Circuits

Two typical oscillator circuits are shown in Fig. 5. That in Fig. 5 (*a*) is a feedback circuit designed for oscillation at 500 kc/s. One of the factors that affect the stability of the circuit is the collector capacitance which varies with collector voltage ($c_c \propto V_c^{-\frac{1}{2}}$); in order to minimise its effect a low value of L/C ratio is used. The circuit in Fig. 5 (*b*) is of the Hartley type; its stability is also enhanced by using low L/C ratio. In oscillator circuits it is important to stabilise the d.c. bias current against the effects of temperature on I_{co}, in the same manner as in amplifier circuits.

Recently Koenjian has described an oscillator circuit of very high frequency stability (changes less than 20 parts per million for a 10 per cent change in supply voltage). This is a transistorised version of a thermionic valve circuit developed by Clapp, the tuning inductance of a Colpitts oscillator being substituted by a series L-C circuit.

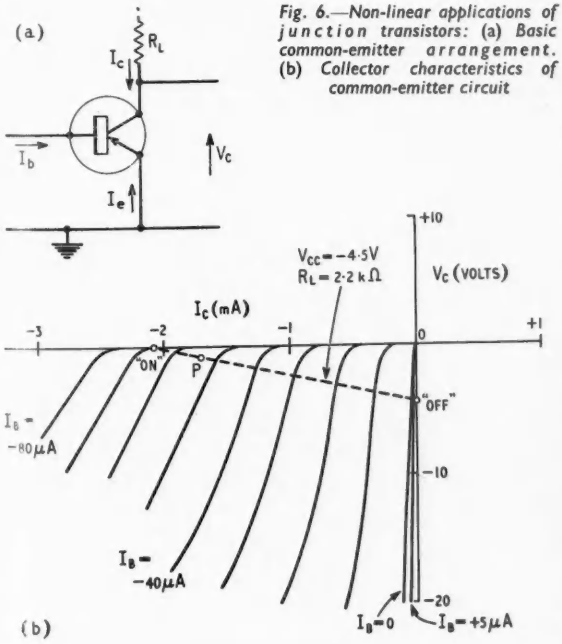


Fig. 6.—Non-linear applications of junction transistors: (a) Basic common-emitter arrangement. (b) Collector characteristics of common-emitter circuit

Switching Circuits

One important feature of the junction transistor is that it can be used as an almost perfect switch. Consider the collector characteristics (Fig. 6) of a common emitter arrangement. In the "off" state the base is held at a potential which is positive with respect to that at the emitter; this need not exceed about 0·2 V. The collector current that flows is approximately equal to I_{co}, and thus the resistance between collector and emitter is very high.

In the "on" state the maximum possible value of collector current is V_{cc}/R_L, where V_{cc} is the supply voltage and R_L is the collector load. If the transistor current multiplication factor is α_{cb}, then the application of a negative base current of magnitude greater than $\frac{V_{cc}}{\alpha_{cb}\, R_L}$ will cause the transistor to go into this high current condition. It is found that the voltage between collector and emitter is of the order of 0·1 V for the low dissipation types of transistors that are currently available. In other words in its "on" state the switch is almost a short circuit. In the region between the "on" and "off" states the transistor has a high current amplification factor. This means that the base current required for switching from one state to the other is very small.

In many applications it is necessary that the time taken by the switch to operate be very short. Most of the available transistors are limited in this respect. In the "off-on" case the transition is governed by effects similar to those due to transit-time in thermionic valves; it is found that the transition can be speeded up by applying a base current which is much greater than the minimum required for switching $\left(\frac{V_{cc}}{\alpha_{cb}\, R_L}\right)$. In the "on-off" case the transition is further slowed down by the "hole storage" effect which is somewhat analogous to a deionisation effect in gas discharge. The technique mentioned above for speeding up the "off-on" transition makes the "on-off" transition much slower. It is therefore necessary to consider carefully which transition is most important in any particular application. The "on-off" effect can be minimised by using a catching diode (which must itself be relatively free of the "hole storage" effect) to prevent the collector potential approaching zero in the "on" state.

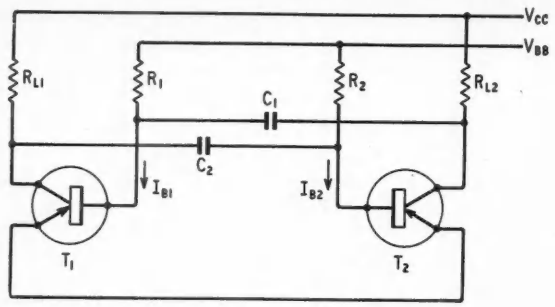


Fig. 7.—Astable multivibrator circuit

The following circuits are examples of the application of transistors in this way.

The circuit of an astable multivibrator is shown in Fig. 7 and it is similar to that used with thermionic valves. It consists essentially of two R-C coupled amplifier stages. If T_1 is momentarily switched off and T_2 switched on an instantaneous positive voltage of magnitude V_{cc} is applied to the base of T_1 through the coupling capacitor C_1. This positive potential holds T_1 off and the base current through resistor R_2 holds T_2 on. C_1 discharges through R_1 towards the base supply voltage V_{BB}. When the potential at the base of T_1 becomes zero, T_1 starts to conduct; this initiates a regenerative action which results in T_1 becoming on and T_2 off. The duration of the on and off cycles of T_1 are thus determined by the discharge of C_2 through R_2 and of C_1 through R_1 respectively.

The time taken by C_1 to recharge after T_1 is switched on depends on the time constant $C_1 R_{L2}$. The " on-off " transition of T_2 depends on the speed with which C_1 recharges and the collector waveform may develop an appreciable " tail " if this time is long. In order to avoid this C_2 should be of low capacitance. However, in order to use low capacitances, it is necessary to use high values of R_1 and R_2 (for a given repetition frequency) and this is not feasible because of the base current requirement to hold a transistor in the " on " state. Some advantage can be obtained by making V_{BB} larger (i.e. more negative) than V_{cc}. It is also advantageous in this type of circuit to use transistors of high current multiplication factor; in the case of thermionic valves with infinite grid-to-anode current multiplication factors this limitation on R_1 and R_2 does not arise and it is possible to use low values of capacitances.

This circuit can be converted for monostable operation by returning one base resistor to a positive voltage. The associated transistor is then normally off but can be triggered into the " on " state by the application of a negative pulse to its base or of a positive pulse to its collector. The mean collector current of this transistor is a measure of the frequency at which triggering pulses are applied; this principle has been employed for rough frequency measurement.

Bistable Circuit

The circuit shown in Fig. 8 is similar to the Eccles-Jordan thermionic valve circuit. It may be held in either of two states (T_1 off, T_2 on or T_1 on, T_2 off) indefinitely and may be triggered from one state to another by the application of a suitable trigger pulse. Binary counters for input pulse rates of 100 kc/s have been made using the circuit shown.

D.C. Convertors

It is often required to produce a high d.c. voltage from a low one. A blocking oscillator type circuit using a junction transistor may be used very successfully. A typical circuit is shown in Fig. 9; as an example, this gives an output of 22·5 V d.c. at 100 μA when operated from a 1·5 V battery and has an efficiency of about 75 per cent.

The circuit behaves as an astable switch. The collector output voltage is stepped up in the transformer and peak rectified; the rectification efficiency can be increased by using a silicon junction diode.

D.C. Amplification

The use of transistors for amplifying d.c. signals is difficult because I_{co} increases with temperature; any change in I_{co} corresponds to a change in the input signal level. Attempts have been made to apply a current to the base to compensate for I_{co}; the design of a suitable compensating circuit to operate over a range of temperatures is difficult. Push-pull arrangements of transistors have also been tried so that effects of changes in I_{co} on the output reading are cancelled; unfortunately the variation of I_{co} with temperature differs from one transistor to another.

With thermionic valves the problem has been overcome by the use of " chopping " techniques in which the d.c. signal is converted to a.c. and then amplified and finally rectified in a phase-sensitive detector. The same principle has been applied to transistors, the basic circuit being shown in Fig. 10 (*a*).

If the " d.c. input signal " terminal (Fig. 10 (*a*)) is short-circuited to earth it is found that a small a.c. output is obtained when a square wave is applied to the base electrode. Part of this signal is due to I_{co} and it is found that the signal can be substantially reduced by reversing the role of emitter and collector in a conventional alloy-type transistor. The I_{co} component is proportional to the value of R_L and it is desirable to keep this as low as

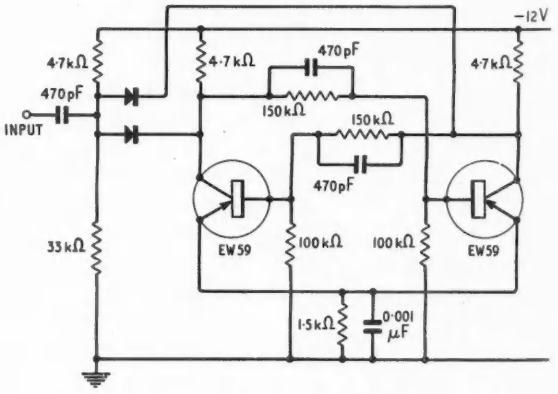


Fig. 8.—An Eccles-Jordan type of bi-stable circuit

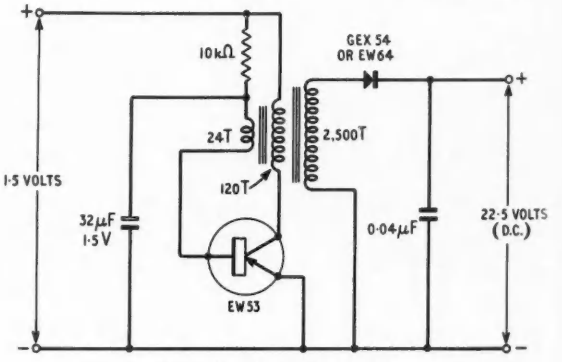
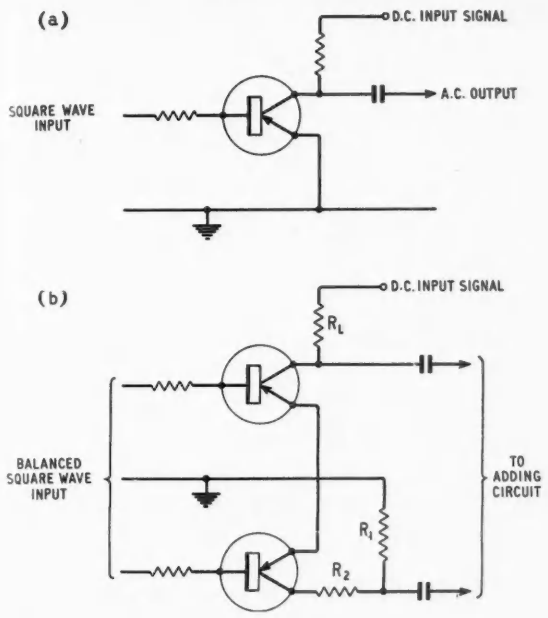


Fig. 9.—Transistor d.c. convertor

Fig. 10.—(a) Basic circuit of a transistor chopper. (b) Balanced transistor chopper circuit



possible. If a d.c. signal is now applied an additional a.c. output signal is obtained which is proportional to the d.c. signal.

The output signal obtained when no d.c. is applied can be balanced out by using a circuit such as shown in Fig. 10 (*b*). In this case a balanced square wave is applied to the two base electrodes and, with the d.c. output terminal short-circuited to earth, the values of R_1 and R_2 are adjusted (R_1 and R_2 usually consist of a simple potentiometer) until a zero output is applied to the adding circuit. When a d.c. signal is now applied, the net output to the adding circuit is proportional to it.

By using an astable multivibrator (with an " on : off " ratio of 1 : 1) of the type mentioned earlier to generate the square wave and connecting separate collector outputs to the base electrode of the amplifier circuit, the adding circuit terminals may be joined together because the outputs from each of the amplifying transistors are already in anti-phase.

Because of the need to keep the value of R_L as low as possible when operating over a wide range of temperatures, the system is mainly useful for measuring d.c. outputs from low source resistance, e.g. from a thermocouple. Nevertheless, d.c. signals of the order of a millivolt may be accurately measured at ambient temperatures of up to about 50 deg C; no difficulty occurs when the temperature decreases.

This " chopping " technique is likely to find a wide field of application, including that of automatic control where the amplifier described may be the first stage of a servo system. Its chief novelty, compared with thermionic valve chopping circuits, is the application of the d.c. signal as the collector supply voltage.

Conclusions

The performance of junction transistors is often limited by parameters connected with frequency response, allowable dissipation, and junction temperature. It is seen that circuits are being designed to minimise these effects so that full advantage may be taken of the immense possibilities of these devices. These circuits also lead to a better understanding of the way in which the devices operate.

Post-Graduate Research

IN his chairman's address to the Scottish Centre of the Institution of Electrical Engineers, Professor F. M. Bruce described some of the post-graduate researches being carried out at the Royal College of Science and Technology, Glasgow, into the mechanism of spark discharge in air and power-follow current phenomena.

Starting from the point that any changes in the current in a discharge carried by the passage of charged ions between electrodes indicated a variation in the ionisation or de-ionisation of the gap, he broadly indicated the causes of ionisation as: collisions between electrons and atoms or excited and normal atoms; temperature rise, which increased molecular kinetic energy; absorption of a photon of the requisite energy level; irradiation by X-rays, cosmic rays, ultra-violet light; and radioactivity.

If the intensity of the ionising agent was reduced, de-ionisation could result from: recombination of positive and negative ions; diffusion of ions from the path of the discharge; cooling in which less thermal agitation improved the possibility of recombination; and pressure increase, reducing the mean free path and therefore the kinetic energy on collision.

A d.c. voltage applied to two-plane electrodes established a uniform electric field across the gap. Ions in the air then moved towards the anode or cathode according to their polarity. Their velocity increased with a rise in voltage and therefore field strength, causing ionisation by collision, which in the limit led to a visible discharge and in some cases to an intensity of ionisation sufficient to carry across the gap the maximum current available from the voltage source. Collisions created more free electrons which might be involved in further collisions to form an avalanche developing toward the anode. In the region nearer to sparkover, however, their experiments had shown the current growth to exceed that accounted for by the primary (Townsend) process and revealed secondary processes, which were discussed in the paper.

With the introduction of high impulse voltages for surge testing, the mechanism of sparkover had to be extended to voltage measurement and to faults on high-voltage equipment. High-speed oscillographs and voltage dividers provided an independent means of voltage measurement, the records having a time ordinate for determining the period between flashover after the application of an impulse. Many gaps exhibited time-lag phenomena, instanced by breakdown on the tail of the impulse wave and not the crest and requiring the application of a peak impulse voltage greater than that at power frequencies. Further studies were discussed in detail, such as those relating to secondary discharges on pin insulators, atmospheric humidity and non-uniform field discharges.

Investigations of power-follow arcs resulting from the impulse breakdown of a gap included those with lightning arrestors and auto-reclosing circuit-breakers which enabled supply to be resumed after de-ionisation of the discharge path.

The Russian Electrical Industry

VISIT OF BRITISH ELECTRICITY SUPPLY DELEGATION TO THE SOVIET UNION

Mr. J. Eccles, deputy chairman (operation), Central Electricity Authority

AT an ordinary meeting of the Institution of Electrical Engineers in London last week Mr. J. Eccles, deputy chairman (operation) of the Central Electricity Authority, gave a lecture describing the recent visit of the British Electricity Supply Delegation to the Soviet Union.

He said that the Soviet Union was engaged upon a great programme of industrial and technical development. The successive five-year plans set targets for each industry and each factory. Each programme was a fantastic exercise in forward planning. The objectives were determined first and the means then worked out in great detail. The number and type of machine tools, the number and range of horse-power of electric motors, the number of tractors, etc., were scheduled. The factories where they were to be produced were listed, the situation, size and type of the new factories determined and, after aggregating all these activities, the motive power required was calculated. From this the size and siting of the power stations was determined.

Last spring a British electricity supply team under Lord Citrine paid a reciprocal visit to Russia following the tour of this country made by the Soviet delegation led by Mr. G. M. Malenkov. In a lecture to the I.E.E. last week Mr. J. Eccles outlined some of the industrial and technical advances in the U.S.S.R.

In the current (1955-60) five-year plan it was proposed to increase the installed electrical generating capacity from 37,000 MW to 75,000 MW. In Britain we proposed to increase the generating capacity from 20,000 MW to about 30,000 MW over the same period. In the Soviet programme 64 per cent of the increase would be conventional thermal stations, 29 per cent hydro stations and 7 per cent (or 2,500 MW) would be nuclear stations.

The largest steam generating sets in operation at present were 150 MW units, operating at 2,400 lb/sq in and 1,050 deg F with reheat to 977 deg F. The standard sizes in use were 25, 50, 100 and 150 MW. Designs had been completed for 200 MW sets and larger units were thought to be possible. So far they had not adopted the principle of one boiler one turbine, even on reheat jobs. The largest hydro-electric sets in operation were 105 MW. These were low head installations operating at 68·2 r.p.m. Designs were ready for 200 MW hydro sets which would operate at 250 r.p.m.

The individual hydro-electric stations were of large output capacity. Kuybyshev and Stalingrad (both on the Volga) would have a capacity of at least 2,100 MW (twenty 105 MW sets each). There was a plan to divert some north flowing rivers into the Volga which would increase the flow and permit of a substantial increase in the capacity of each of these stations. Stations were planned on the Yenisei and the Angara rivers, each of which would have eighteen 200 MW sets giving a station capacity of 3,600 MW.

These large-capacity hydro stations were for the most part situated far from present centres of population and hence the Government was faced with the alternatives of transferring large groups of people to the power production centres and establishing industries to use the power locally, or transmitting the power to the people over long distances. In practice, they were doing both of these things. A town of 50,000 population was springing up north-east of Stalingrad with the appropriate quota of industries to absorb part of the power that would be produced by the new station there.

In addition, they had built a 400 kV double-circuit line from Kuibyshev to Moscow (505 miles) and proposed building a similar line from Stalingrad to Moscow to carry part of the output to the metropolis. The general pattern of power production seemed to be first to build combined heat and power stations in the cities so as to provide a heating service in a big way. These stations were fired by coal, oil or natural gas, which had to be transported a long distance—in some cases 800 miles. The capacity of these stations was governed by the industrial and domestic heating requirements. There were about 100 of these combined power and heat stations in the U.S.S.R. Secondly, normal (condensing) electric power stations were being built near the coalfields and hydro stations on the great rivers, and the energy that was not used locally was transmitted to the cities and districts remote from these energy sources by means of very-high-voltage lines.

There was a 400 kV line in operation between Kuibyshev and Moscow, and other lines at this voltage were being planned. An experimental 200 kV d.c. line was in service over a distance of 75 miles near Moscow. An 800 kV d.c. line 300 miles long was being constructed between Stalingrad and the Donetz Basin. If this was successful they planned to standardise on 1,000 kV for their long-distance d.c. transmission between Siberia and European Russia. In all cases the centre point of the d.c. circuit would be earthed.

Plant Manufacture and Research

Practically all the plant and equipment now being installed was manufactured in the Soviet Union. The delegation saw a turbine works and an electrical generator works in Leningrad, each employing 10,000 people. A transformer works employing 4,000 at Zaporozhie and a switchgear works employing 7,000 at Sverdlovsk were visited and cable factories at Moscow and Leningrad were also seen. Generally speaking, the standard of workmanship was good, but the tooling varied from very modern to mediocre.

Transport of heavy loads to isolated sites seemed to present problems. The cores and windings of large transformers were transported in light gas-filled enclosures. The tanks were fabricated and assembly was completed on site. Extensive fabrication of sections of boilers was carried out on open sites near the power station and these sub-

assemblies weighing from 30 to 60 tons were moved into the station on special bogies and placed in position with the aid of overhead cranes.

Research in the Soviet Union was extensive and intensive. Part of the delegation visited a thermo-technical research institute where an experimental boiler was operating at 4,600 lb/sq in and 1,100 deg F. The institute was founded in 1921 to investigate the utilisation of low-grade fuel. There were 27 laboratories and an experimental power station associated with the institute. The design and performance of all types of boiler, turbine and control equipment were investigated.

A nuclear research institute was visited where a particle accelerator operating at 680 MeV had been in operation since 1949. A more powerful accelerator designed to operate at 10,000 MeV was in an advanced stage of construction. This was a race-track synchrophasotron and consisted of 88 electro-magnets arranged in four quadrants on a track radius of 92ft. The space between the quadrants was used to inject particles, to remove particles, and for measurement. The supply for the magnets was provided by four twelve-phase motor-driven 750 r.p.m. alternators equipped with heavy flywheels. These fed ignitrons, each of which had an output of 800 A. A peak current of 12,800 A flowed through all magnet coils in series. There were five impulses per minute, the current rising for 3·3 sec and decaying for 3·3 sec with a 5·4 sec pause between pulses. The peak value of the pulse was said to be 170 MW. The building, which resembled the Albert Hall in size and shape, was unshielded because the magnets were constructed to form a shield for the track.

The experimental nuclear power station was visited. Briefly, it consisted of a pressurised water reactor with 128 channels, the effective length of each fuel channel being 67in. The water pressure was 1,500 lb/sq in, the inlet and outlet temperatures being 374 deg F and 554 deg F respectively. The rated electrical output was 5 MW. At the time of the visit the output was about one-third full load. An experimental high-voltage d.c. and a.c. laboratory in Leningrad was also visited.

Technical Education

The educational system in the U.S.S.R. was making a vigorous effort to meet the needs of a rapidly developing industrial economy. There were 33 universities, about 800 technical colleges and 220,000 general educational schools in the Union. Seven years' free education, from age seven to fourteen, was compulsory throughout the Union; in some cities ten years' education, from seven to seventeen, was compulsory and the hope was that this would eventually become universal.

It was said that 37 million children were receiving a general education and that more than a million-and-a-half students were enrolled in the schools of higher learning which included the universities and technical colleges. One of the latter, the Molotov Technical Institute, Moscow, was visited. Here there was a student population of 11,000 of whom 32 per cent were women. The college was divided into ten faculties—electric power; thermal power; hydro power; design and construction of electrical plant and equipment; electrification of industry and transport; utilisation of heat; electrical vacuum techniques; telemetering and computing; radio, radar and television; and a general faculty for evening studies. The average age at entrance was 17½ years. Candidates had to pass examinations in mathematics, chemistry, physics, Russian and another language, the pass mark being 80 per cent.

During the first year the education was general. In the second year the student must choose between mechanical and electrical engineering and during the third, fourth and fifth years, his studies were confined to the faculty in which he had elected to graduate. The course lasted five years with six months added for the preparation and presentation of the thesis. Each successful student was awarded a diploma which indicated the branch of engineering in which he had qualified. This diploma was a common award for all technical colleges but the name of the college was inscribed on it and this had some significance to employers who seemed to be aware of college reputations. Each session lasted 9½ months with two months' break in summer and two weeks in winter. Students were exposed to practical training for three periods of about two months each during their five-year course. Eight per cent of the time in the early years was devoted to instruction in Marx-Lenin political economy. No fees were charged and most students received maintenance grants of between 300 and 500 roubles a month. The Director administered these grants and the amount paid to each student was determined by his progress in his studies.

"Carrot and Stick"

Similarly, although the professors and teachers were paid higher salaries than were paid for comparable posts in industry, their period of appointment did not exceed five years and re-appointment was preceded by an appraisal of performance. The "carrot and the stick" were used to stimulate teachers and students alike. The Director, 60 professors, 800 teachers and about 2,000 additional personnel constituted the staff of the Molotov Technical Institute.

A list of situations vacant was posted at the college about three months before the date of graduation. Shortly thereafter the final-year students were interviewed by the Director and a panel of industrialists. If a student had a clear idea as to what he wished to do and there was a suitable vacancy, the matter was settled, but if he had no positive ideas his future work was determined by the panel after about twenty minutes' discussion. Evening students studied for six years and the successful ones received the same diploma as the full-time day students. There were 1,200 evening students and they attended classes for four hours on each of three evenings a week throughout their six-year course.

Industrial Policy

Mr. Eccles' impression, gained after three weeks' travel, study and observation, was that of a people pressing forward with an industrial revolution under a political doctrine which allowed little scope for the expression of human personality or human waywardness. The whole system was dedicated to an idea which was expressed in the trite phrase "from each according to his ability, to each according to his work." This was said to be the first phase, the second and final goal being "from each according to his ability, to each according to his need."

In the process there was a degree of regimentation of effort and ideas of which there was no equivalent in western countries. Criticism was permitted so long as it was criticism of individuals rather than of the system. Knowledge of the outside world had not been made available to the general public and foreign travel had been virtually prohibited.

Hence, one saw a people with no basis for forming judgments other than that which had been communicated to them by the Ministry of Culture. They were a people who in the main exhibited a stolid acceptance of things as they were, which emerged into cheerful enthusiasm in those engaged on great construction projects. Unquestionably, they were better off in a material sense than they had ever been before, even though the standard of life and comfort

was considerably below that of the British people. But relative to their own past they were better off, and this to them was perhaps the strongest vindication of the system. Basic wages had remained constant since 1947, bonuses had increased during this period and the prices of commodities had tended to come down.

The people were very friendly and had a delightful sense of humour. Music and the arts played a large part in their cultural life. This characteristic and these expressions of the things of the spirit were perhaps the two most hopeful signs in a civilisation which tended to regiment thinking and suppress opinion.

Industrially, they were on the march. Soon they would be able to supply all their needs and enter the export market on a substantial scale. We were witnessing a great experiment in a particular brand of civilisation. What the future held was anybody's guess but it seemed inconceivable that it should remain insulated from the ebb and flow of ethical and political opinion and practice which moulded the sense of values in other lands. These visits might be an indication that there was an awareness of this need. On the other hand, their belief in the rightness of their system was so profound and the missionary zeal to propagate it so evident that we should have to show beyond a peradventure that ours was the better way before any liberalising thoughts could begin to take root. It would seem that the international problems of the future between east and west would centre upon competition in ideas for the satisfaction of man's spirit and competition in commerce to secure his bread and butter.

Visit to Russian Hydro Installations

LAST week Sir John Hacking (Merz & McLellan) and other members of the British delegation of hydro-power experts which recently toured European Russia inspecting various hydro-electric installations, gave an interview to the electrical Press.

Sir John first outlined the itinerary of the tour and then completed his story mainly in the form of answers to questions. At the outset he stressed that there would be an official report published later and that at this stage, although an interim account might be useful, accuracy could not be guaranteed, mainly because members of the delegation had not yet been able to compare and agree on individual notes and because of language difficulties.

Sir John said that on 10th October they flew into Moscow, where they stayed for two days, and then south to Erevan, near Lake Sevan. This lake was being reduced to a level of one-sixth by evaporation in fifty years, and the 600,000 kW hydro station which it would serve was one of eight cascade stations; it was actually on the River Rzdan, a tributary of the River Arax. On 15th October they motored nearly to Tbilisi and visited the undertaking on the River Kharam where there was a 112,800 kW station in commission, a second station under construction and a third station projected. They then flew nearly to Stalingrad which had the lowest of the stations on the Volga. There were three old stations in commission at the north of the Volga, and Kuibyshev station, under construction, would have a capacity of 2,000,000 kW.

On 19th October they flew west and over the lake created by the Kakhovka power station. This lake would have a storage capacity of 6,000 million cu m and a capacity of 6×52 MW; the overall head was 27 m. A day later from Zaporozhie they flew to Kiev and then nearly to Leningrad, finally returning to Moscow.

During the tour they saw various research laboratories, including one in Moscow, and they visited a number of factories, including one in Leningrad, where turbines were produced. In the Moscow laboratory research in turbine design was being carried out and the changing of blade pitch seemed to be most useful work. They also worked on stresses and on a study of underwater sluices, the effects of water hammer and stresses on alternator shafts. They got the firm impression that Russian planning was sound. There was evidence of loose co-operation between all the research establishments visited, but it seemed that each dealt with local problems although it contributed to the work of the whole.

During their visit nuclear power was dealt with only slightly and it seemed that the Russians did not think that nuclear energy would influence the development of the hydro work to any appreciable extent.

The delegation understood that the European hydro development would be finished in 1965 and that by 1960 the output from the hydro stations would be something like 59,000 million kWh, which would be 80 per cent of the total output of all the stations, that is hydro and thermal stations.

The Russians seemed to have got the "know how" of establishing dams on permeable soil, but the delegates saw nothing that had not already been established in America. This did not imply that soil dams were the general practice because the Russians built to suit the locality and there were prominent concrete and rock-filled dams.

The Russians were putting up stations very quickly; $3\frac{1}{2}$ years was a reasonable time for a sizeable station with all round the clock working, this representing mechanisation on a really large scale. A more general note was the enthusiasm with which the Russians showed their visitors their new towns, particularly the amenities—sports fields, theatres, and concert halls.

Impregnating Varnishes

AMONG the latest standards to be issued by the British Standards Institution is B.S. 2778, which supersedes B.S. 119 : 1930, "Clear Baking Oil Insulating Varnish for Electrical Purposes," and B.S. 514 : 1933, "Baking Insulation Varnish (Bitumen Type) for Electrical Purposes."

When the two old standards were produced the so-called synthetic varnishes had not come into general use and the opportunity has now been taken to include these varnishes in a general specification for impregnating varnishes. A test for polymerisation has been incorporated.

A considerable reduction has been made in the maximum permissible drying time to bring this into accord with current practice and the drying must be carried out at any one of the stated temperatures. The determination of resistance to moisture now calls for total immersion instead of subjection to 95 per cent relative humidity, and the test for ageing has been amended and is now called a test for the effect of heat ageing on flexibility.

Although the specification does not require that the varnishes should be suitable for use in insulating oil, many of them will in fact be suitable. Some varnishes complying with this specification will be affected by contact with cutting oil. No clause has been included to cover this property and where contact with such oil is likely the varnish maker should be consulted.

Copies of this standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 3s.

Calder Works Plant

DESIGN PROBLEMS AND FUTURE DEVELOPMENTS

A SYMPOSIUM on the Calder Works Nuclear Power Plant, organised by the British Nuclear Energy Conference, is to be held at the Central Hall, Westminster, on Thursday and Friday next. Some twenty papers will be presented under the broad headings of general design, technical research problems, engineering design, light and industrial engineering and future developments. Each group of papers will be introduced by a rapporteur and followed by a discussion.

At the opening meeting on 22nd November the chair will be taken by Sir John Cockcroft and three papers on the design of the Calder Hall reactor are to be read by Sir Christopher Hinton; Messrs. R. V. Moore and B. L. Goodlet; and Mr. R. V. Moore.

Reviewing "The Place of the Calder Hall Type of Reactor in Nuclear Power Generation" Sir Christopher Hinton says that owing to the difficulties of finding suitable sites in the United Kingdom the graphite-moderated gas-cooled reactor, which is inherently stable, was investigated. At Calder Hall the primary product is plutonium for defence purposes and electrical energy is a by-product. It would be misleading from the industrial point of view to talk about the cost of power produced in the Calder Hall reactors as this can only be determined for reactors which are "optimised" for the production of electrical power and which produce plutonium as a by-product. The differences in design required by a re-optimisation for power production purposes are, however, quite minor and the Calder Hall pile has the distinction of forming the basis of the world's first comprehensive long-term programme for the development of nuclear power.

Some Reactor Properties

The reason for this is that in designing the Calder Hall reactors the best and most reliable design which could be obtained with the available materials was used. The reactors are heavy, cumbersome and expensive in capital cost per kW, but are inherently safe and the materials used in their construction have been in routine production for a considerable time, the techniques being well established. Reactors of the Calder Hall type can produce power at a cost comparable with that of a modern station using conventional fuel. Potential improvements in this type of reactor mean that they will still be built 25 years from now, although by using liquid coolants the ratings will be higher. Nevertheless, the development of those other systems which are not industrially attractive must be pressed forward.

An account of the work done at Harwell from 1951 onwards on a graphite-moderated reactor, cooled by gas under pressure, will be given in a paper by Messrs. R. V. Moore and B. L. Goodlet. After stating the basis of the general design of the plant and its main features the authors will discuss the problems of designing a reactor as they appeared in 1951. A design to give the best overall performance will then be described, while details of the actual construction of the pile, its auxiliaries and the methods of operating will be given. The salient economic fact which emerges from this work is the high cost per kW installed, in comparison with coal-fired stations, although developments are visualised which will lead to a material reduction in this figure. The cost per kWh of output will be about 1d, neglecting any value for residual plutonium.

Electricity and Plutonium

The design and construction of the Calder Hall plant will be dealt with in a paper by Mr. R. V. Moore. The original design, which laid emphasis on the production of electricity, was reviewed to define the changes necessary when this emphasis was shifted to the maximum output of plutonium. In spite of this change it was decided to maintain the main form of the original design; to increase the heat output of the reactor by lowering the temperature of the coolant returning from the heat exchangers to the reactor; and to improve the conversion ratio by squeezing the lattice pitch. This procedure could not be pursued without cost and then only within certain limits. All factors having been considered, the value of 140 deg C for the inlet temperature to the reactor was selected. To achieve a degree of flexibility the main CO_2 circulations were designed to deal with a mass flow 10 per cent above the designed point. This precaution ensured that reasonable discrepancies could be absorbed without prejudice to the plutonium output of the plant. At the same time the steam and electrical plant was designed to have continuous overload output, so that in the event of improvements the output would be increased above the designed point value.

The features of the carbon-dioxide cooling system and the precautions which had to be taken in its use, the structural design of the reactor itself, its shield, core and pressure vessel will also be dealt with at length. The various operating features will be described, together with the generating plant and its auxiliaries and the various control and safety equipments. Some of the constructional difficulties encountered will be outlined.

Technical Research Problems

The meeting on technical research problems, which is to be held on Thursday afternoon, will be presided over by Sir John Cockcroft, and four papers will be presented. The first of these is by Messrs. P. Fortescue and W. B. Hall on "Heat-Transfer Experiments on the Fuel Elements," in which the authors point out that the object in the design of the heat-transfer surfaces in a nuclear reactor is to achieve the greatest possible heat release from fuel at a given temperature and with an economical power expenditure in the coolant circulations. If the electrical power is generated from the heat output of the reactor the temperature of the coolant is also important. The process of heat removal from the reactor cannot be dealt with as an isolated problem, but must be integrated with the nuclear, metallurgical and structural design. The greatest difference between the heat transfer problem in a reactor and that in most industrial plants is in the limitations imposed by nuclear design. These limitations govern the disposition of the fuel in the coolant channel, the size of the channel and the amount and nature of the material that might be used.

The paper recounts the work that led to the heat transfer surfaces employed on the Calder Hall fuel elements. During the development of this element certain interesting applications of the basic principles of heat transfer by

forced convection were brought to light. Of particular importance in reactor cooling with gas is the use of extended surfaces and the theoretical problems associated with the form of heat release along a reactor channel.

As regards the evolution of the Calder heat transfer surface, a survey of experimental data on compact types of heat transfer surface, such as spines normal to the primary surface, interrupted plane fins and wire coils, suggested that if economy in pumping water was the criterion smooth longitudinal fins, as that shown in Fig. 1, would give the best results. It soon became evident, however, that lack of mixing of the coolant in a radial direction was the main cause of the discrepancy between experimental and predicted heat transfer coefficients. A typical radial temperature distribution measured between two fins is shown in Fig. 2. The first attempts to rectify this situation were directed towards removing the air bodily from between a pair of fins and replacing it by cooler air from the outer region of the channel. No suitable means of achieving this without incurring an excessive pressure drop was found and further work was devoted to the development of turbulence-promoting devices that would be fitted outside the radius of the fin tips. The most effective of those tested is shown in Fig. 1. The improvement in heat transfer was obtained only at the expense of an increased pressure drop. Only the fuel elements in the hottest region of the channel, however, required turbulence promotion and a net increase in the heat output was achieved.

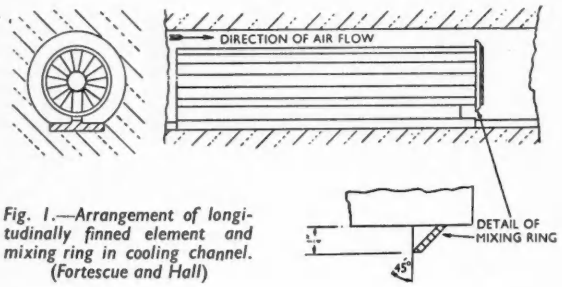


Fig. 1.—Arrangement of longitudinally finned element and mixing ring in cooling channel. (Fortescue and Hall)

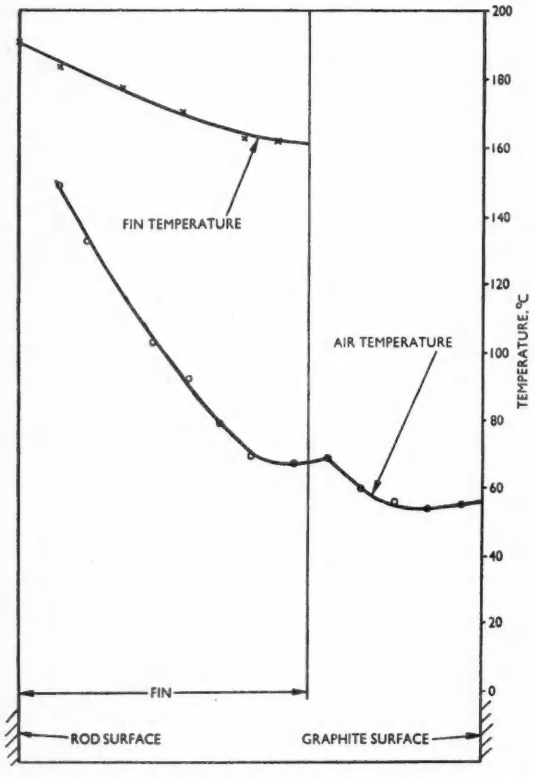


Fig. 2.—Typical fin and air-temperature distribution with longitudinal fins. (Fortescue and Hall)

Experimental Methods

The heat transfer problem in a reactor is basically the same as that in an electric heater, since the heat release is independent of the temperature of the fuel. This and the fact that the electrical heat input can be measured easily and accurately made electrical heating of the apparatus most suitable. It had the further advantage that the local heat transfer coefficient along the channel was determined and entrance effects could therefore be separated from the fully developed conditions existing farther along the channel. By carrying out experiments with a linearly increasing and then a linearly decreasing heat output along the channel the effect of distribution of heat release was found to be negligibly small in this particular case. The effect of heat flux distribution assumes importance as reactors become more highly rated and this is being investigated separately.

Experiments were made on the Windscale reactors, which are cooled by air at atmospheric pressure, longitudinally finned elements being used. At Leicester investigations were carried out on transverse finned elements, this work providing the basis for the study of the Calder Hall reactors. The results of these experiments are to be given in detail in the paper.

Basic Physical Problems

" Experimental Physics " will be dealt with in a paper by Mr. P. W. Mummery, who says that it is the function of a reactor physics research programme to provide the information from which the interaction of the effects of coolants, structural materials, neutron spectra in the reactor, the dispersion of the fuel elements and the use of thorium as a fertile material can be evaluated. There are three basic problems to be solved in providing the reactor designer with information he needs. The condition for criticality of the system must be evaluated as a function of the composition and size of the system, of the concentration and disposition of the materials in the reactor and of the temperature and power at which it is operated. Account must also be taken of long-term effects due to the changes in the types of materials present resulting from neutron capture. Finally, the dynamic characteristics of the system and the rate of heat production at all points of the system must be known as a function of the variables concerned.

The effects on criticality of graphite purity and density, of gas coolant channels, of element shape and size, canning material and enrichment will then be discussed and the associated experiments described. The fundamental properties of the important isotopes have now been fairly well established, but more integral experiments are necessary. The effect of the plutonium isotopes is largely dependent upon the form of the neutron spectrum and the concentration of the plutonium, owing to the large cross section resonances at the very low energies. The most useful integral experiments, which require only a few pounds weight of material, have been the oscillator experiments with irradiated uranium. By this technique uranium bars are compared in a low power reactor before and after various irradiations in a high power reactor. Thus the effect of irradiating the uranium in a complete reactor can

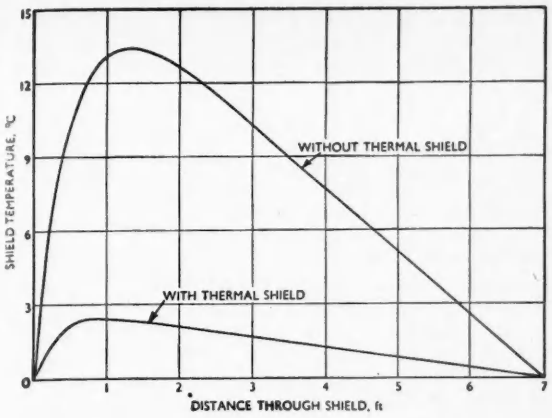


Fig. 3.—Temperature rise in shield. (Horton and Bonsall)

be predicted. It is believed that an irradiation level corresponding to a heat extraction of about 3,000 MWD per tonne will be possible with a Calder Hall type of reactor.

Shield Design

In the next paper which is to be presented at the meeting on Thursday afternoon Messrs. C. C. Horton and W. B. Bonsall point out that a number of problems arise in the design of the shield for a power reactor among which is the arrangement of the bulk shield, activation problems in the coolant and other reactor materials and the removal of heat. The methods employed in attacking these problems in the Calder Hall system will be illustrated and their relative importance examined.

The Calder Hall system forms an exceedingly complex source of penetrating radiations and, to obtain solutions in a reasonably short time, many approximations were used to simplify the "geometry" of the problem. To be able to cool each component of the reactor shield, so as to prevent serious thermal stress and excessive temperatures in the concrete, a detailed analysis of the heat sources was made. The maximum heat input occurred on the vertical and horizontal centre lines of the reactor because of the peaking of the neutron flux. Detailed analysis was therefore carried out for these cases only. The sources of radiation considered were: gamma radiation due to neutron capture in the reflective pressure vessel thermal shield and concrete and kinetic-energy loss by fast neutron scattering in the shield components. The energy absorbed from gamma radiation was readily calculated and the radiation flux from each source could be deduced. An expression for the rate of heat production per unit volume was given. When the distribution of heat sources in the shield had been obtained an empirical fit to this distribution in the form of a single exponential function was made for each section to simplify the task of calculating the resultant temperature rises in the shield.

The temperature variation in the shield resulting from the heat distribution discussed is given in Fig. 3 for the side face of the reactor. It will be seen that the maximum temperature occurs at about 1ft from the inside face of the concrete. This value is typical of thick concrete shields. As a rough rule of thumb the maximum temperature rise in a concrete shield is about 0·5 deg per B.Th.U. per sq ft of heat input.

Basic Reactor Design

Basic reactor design is to be dealt with by Messrs. G. Packman and B. Cutts in a paper, which will also be presented on Thursday afternoon. The reactors at Calder Hall are based on a study from which four important factors influencing basic design emerge. Magnesium had been discovered to capture neutrons to a smaller extent than had at one time been thought. This meant that the fuel elements could be contained in a sheath which would absorb relatively fewer neutrons than the thin aluminium cans of previous fuel elements. The quality of the reactor type graphite had been improved so much that its absorbing power had dropped nearly 20 per cent below that of the Windscale reactors. In air-cooled reactors valuable reactivity was lost by the absorption of neutrons in nitrogen. The decision to use carbon-dioxide as a coolant made this reactivity available for other purposes. Finally, the diffusion plant had come into operation. This meant that, if necessary, a small amount of enriched uranium could be used to improve the reactor charge should the reactivity of the reactor as built be too low for operational requirements. The achievement of a natural uranium reactor was, however, regarded as of the utmost importance. If this flexibility had not been available the core diameter of the reactor might have had to be about 4 or 5ft greater to ensure enough reactivity in hand to guarantee the operation of the reactor under design conditions.

These four factors made it possible to specify a core with 1in diameter rods on an 8in lattice, of active size 21ft long by 31ft in diameter. This was much smaller than had previously been thought possible at the desired rating and temperature. Two reactors were built at Calder Hall on the lines indicated in the study, but as the emphasis was shifted from electric power to plutonium production it was necessary to make a new survey of lattice parameters. The paper summarises the work of three years up to March, 1953, during which improvements were made in the basic data and the methods of calculation. Changes were also made for loading the reactor with natural or enriched fuel, if the use of the latter proved necessary.

The paper is divided into two main parts dealing with nuclear calculations and coolant calculations, respectively. The work on the first can, for practical purposes, be considered in three stages. In the first phase the design had to be revised to achieve the aim of producing plutonium in an economical manner. The core diameter was therefore fixed at 30ft and for each lattice pitch and rod diameter combination the fuel enrichment was calculated which would make the reactor work at the highest possible power. The results of this survey for the highest channel heat output are shown in Fig. 4. It was clear that the fuel

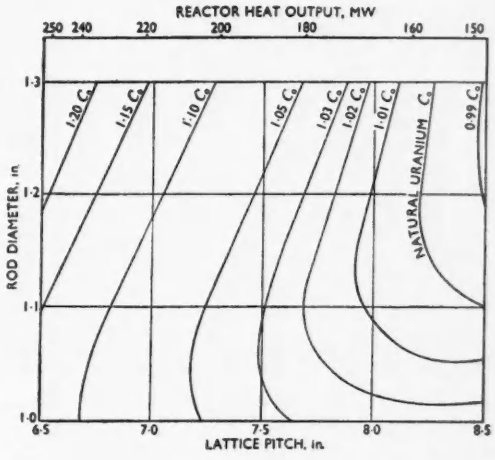


Fig. 4.—Lines of constant enrichment on plot of rod diameter against lattice pitch. (Packman and Cutts)

element had to be about 1·1in in diameter and the lattice pitch not less than 7½in to avoid a heavy bill for enriched fuel.

These survey calculations were made when such data as the spacing between the individual uranium cartridges, the channel diameters, the actual quality of the graphite that would be available and the amount of uranium canning material that would be required had still to be determined. By early 1954, however, all the important data affecting the nuclear calculations had been fixed so that a new set of calculations could be made to assess the nuclear parameters of the reactor and to determine the enrichment required for operation. A year later a revision of the data used in the lattice calculations was made, the effect being to increase the reactivity of the Calder Hall lattice by about 0·7 per cent. This meant that the fuel charge, instead of including a large proportion of enriched uranium fuel elements, would be almost entirely natural uranium. The nuclear calculations were therefore revised once more. To "trim" the reactor and to allow for the uncertainties in reactivity some steel absorber bars and some enriched uranium fuel elements were provided along with the initial charge of natural uranium.

In the calculations of coolant, which are also dealt with in the paper, the unit is the individual fuel-element channel. The critical parameters are the coolant inlet and outlet temperatures, the limiting fuel element temperature, the heat removed and the power required to pump the coolant through the channel. From a set of calculations on pressure drop, details of which are given in the paper, it is possible to choose a range of channel heat outputs for which nuclear calculations can be made. These, in turn, give heat-output distributions across the core and hence the reactor heat output, the total coolant mass flow and the bulk outlet temperature.

Two aims of the basic design were to achieve a chain reaction under design conditions with natural uranium as the only fuel, combined with a certain designed heat output. It was certain that the first objective would be successfully met. In fact, it has not been necessary to use any enriched uranium, but rather to replace some fuel elements by steel absorbers. The former output of the plant has been developed to a value close to the design and it is probable the latter will soon be reached.

Metallurgical Problems

At a second meeting on Thursday afternoon two papers of metallurgical interest will be discussed. The first of these, by Messrs. R. A. Y. Huddle and L. M. Wyatt, describes the work carried on at Harwell in connection with the 1951-53 design study. The activities were concerned with the economical fabrication of the uranium into the precise form required by the design; the attainment of the correct metallurgical structure so that the fuel element retains its shape, within acceptable limits, throughout its working life; and the provision of an appropriate sheath or can. This had to have a low cross-section to thermal neutrons, good resistance to coolant attack and be compatible with the uranium under operating conditions. To protect the uranium from attack by the coolant gas and to prevent the escape of fission products it must have good sealing characteristics. It must be able to resist or accommodate the stresses imposed by the fuel during operation and in some cases help to support the uranium. This implies good ductility combined with adequate strength. It must also have good thermal conductivity and provide extended coolant surfaces for heat transfer. Finally, there are general problems associated with the reactor as a whole; in particular, the choice of the most appropriate metal for each application has to be considered.

The work described in the paper shows that by the end of 1953 a reactor of the type envisaged was feasible. With the possible exception of beryllium, which was originally considered as a support for the fuel elements, it was decided that no advantage was to be gained by the use of unusual materials. The use of alloying to improve the creep strength and to eliminate phase changes would be effective in reducing the swelling in uranium metal as would the use of a strong can. These remedies all detracted from the neutron economy of the reactor, but improvements in irradiation resistance might be obtained. Alloys containing 1 to 3 per cent zirconium had been found to have a rate of resistance to carbon dioxide 10 to 15 times less than the unalloyed metal at 500 deg C.

As a result of two programmes on the subject of materials for pressure vessel construction it had been found possible to obtain improved resistance to oxidation and creep at high temperatures on normalised specimens without increasing the tendency to brittle fracture; and it appeared that a steel possessing the appropriate characteristics for reactor pressure vessels could be developed.

In the second paper which will be introduced on Thursday afternoon, metallurgical developments are dealt with by Messrs. L. Grainger and A. B. McIntosh. This covers the work that has been done on steel for pressure vessels, with the manufacture of uranium bars and the design of the various magnesium alloy cans used at Calder Hall.

All this work has assisted in the construction of the pressure shell and greatly helped the design, commissioning and operation of the fuel element production line. It cannot yet be said that a similar contribution has been made to the satisfactory and economic operation of the Calder Hall reactors. The experience gained and the methods of fuel element analysis developed will, however, assist not only in the solution of any operational problems that may arise, but also in the further advancement of reactors of this type.

Radio Engineering

IN his presidential address to the British Institution of Radio Engineers on 31st October, Mr. G. A. Marriott (General Electric Co.) said that the annual turnover of the radio industry in this country was about £300 million. This included £40 million for export, which was twenty times the pre-war figure. In 1938 Great Britain produced 12·5 million valves compared with 64 million last year. The ratios of increase in different classes were: broadcasting entertainment (mainly television), 5; Services, 7; industry, 30.

To set up a modern valve factory would cost about £3 million. During the war the demand for the new form of valve capable of transmitting the very strong pulses required by radar exceeded Britain's productive capacity, so sample valves with a colour film of the manufacturing processes were sent to the U.S.A.

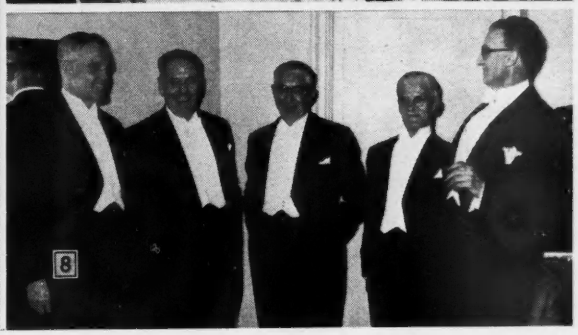
Many years must elapse before new schemes of technological training could benefit industry and school leavers were recommended meanwhile to take an apprenticeship course. The prospects for engineers in production were probably at least as great as those in research and development.

In 1938 the British valve industry, as pioneers of television, produced 10,000 cathode ray tubes; the present number was well over 2¼ million and the emphasis was on improved production methods, largely by means of tunnel pumps. Transistors would not materially affect valve requirements for some years as many problems were still outstanding in the economic production of semi-conductors, though the basic materials cost only one-twentieth of those of valves.

ELECTRICAL INDUSTRIES BALL

THIS year's annual dinner and ball organised by the Electrical Industries Benevolent Association at Grosvenor House, London, W.1, was again a conspicuous success. Most of the leading people in all branches of the electrical industry appeared to be present among the thousand who attended. The guests were received by the president, Mr. Harry Riley, and his wife, and after dinner Mr. Riley, in the briefest of speeches, announced the dispatch of a telegram of loyal greetings to the Patroness of the Association, Her Majesty the Queen, and the receipt of a reply. He called for generous support in the purchase of programmes (which were presented by the A.E.I. Lamp & Lighting Co., Ltd.) and contributions to the customary collection. The result was that £584 was raised from the sale of programmes while the collection realised £239. Altogether the Association has benefited by over £1,500. Forty prizes were contributed by as many electrical and allied firms, to whom the Association's thanks are due.

Music for the dance was provided by Stanley Black's Orchestra and there was a midnight cabaret.



1. *Among the people at this table are Messrs. L. C. Penwill, H. St. J. Donisthorpe, A. H. Gambling and Mr. and Mrs. V. W. Dale.* **2.** *The President (Mr. Harry Riley) and Mrs. Riley with Mr. and Mrs. C. Hughes.* **3.** *Mr. and Mrs. M. R. Neville and Mr. and Mrs. A. V. Clarkson are included in this group.* **4.** *The company at this table includes Mr. and Mrs. J. Eccles and Mr. R. H. Coates.* **5.** *Mr. and Mrs. C. R. King and Mr. and Mrs. W. Lewis Smith being received by the President and his wife.* **6.** *Messrs. J. J. Thompson, W. L. Wray, H. F. Wickham, J. A. E. Trinder and E. B. Sawyer are seen in this photograph.* **7.** *Group includes Mr. and Mrs. E. R. Wilkinson and Mr. V. A. Pask.* **8.** *Messrs. M. R. Neville, C. R. King, Harry Riley, F. E. C. Miller and H. Senior Fothergill (secretary, E.I.B.A.)*

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Nuclear Fission and Neutrons

YOUR very interesting article "Principles of Nuclear Power Engineering," which was published in the 25th November, 1955, issue of the *Electrical Review* and reprinted in an abridged form in the 19th October, 1956, issue appears to contain an error. I quote from the latter version (the original is similar):—

> "In fission an average of 2·5 neutrons are also freed from the nucleus; and these have energy far above thermal values. At ordinary temperatures thermal energy is about one-fortieth eV, whereas 'fission' neutrons have an energy of about 1 MeV. If, in fact, one of these *thermal* neutrons enters into further fission then . . . ."

The implication is that these latter neutrons are *not* thermal neutrons, and in fact that the purpose of a moderator is to reduce the energy of fission neutrons to thermal values.

London, S.W.1. T. J. MURPHY.

The author, Mr. D. V. Wordsworth, replies as follows: Neutrons released in fission are indeed fast neutrons, having energies higher than thermal values. It is our purpose in reactor design to persuade one of these fission neutrons to enter into further fission and so promote the chain reaction. As discussed in the article, it is not possible to maintain a chain reaction with fast neutrons in natural uranium, and the solution lies in using a moderator to reduce the neutron energies to thermal values. The probability of fission occurring is then high enough to ensure the chain reaction.

The sentence referred to by Mr. Murphy was written with this in mind, but I would agree that as set down it would be more accurate to omit the word *thermal*.

Electrical Industry's Trading Structure

SOME doubt seems to have arisen in various quarters as to the attitude of the N.E.C.T.A., Ltd., and the electrical contracting and retailing industry which it represents. I would, therefore, take this opportunity of making clear the policy which we consider to be in the best interests of the industry.

We are satisfied beyond any measure of doubt that it is to the public benefit that trading conditions in the home market shall possess the utmost stability. Service to the public can only be established on the basis of a fair reward to the contractor and retailer for the services which he is called upon to render at the time of sale and thereafter. Stability of trading conditions is a fundamental prerequisite upon which the foundations of a sound trading structure and of service to the public can be built.

I am convinced that stabilised trading conditions can only be effectively and permanently established as a result of collective negotiations between the organisations representative of the interests of electrical contractors and retailers on the one hand and of manufacturers on the other. It would not be possible to achieve the end desired if every manufacturer had his own exclusive trading policy which varied according to the particular conditions which apply at any moment and had no regard for the stability of the industry in general. For that reason, therefore, it is the firm policy of the N.E.C.T.A. to extend mutual recognition to the organised sections of the manufacturers and to seek their co-operation in the establishment and maintenance of a stable trading structure.

London, W.C.1. L. C. PENWILL,
Director and Secretary,
N.E.C.T.A., Ltd.

Heavy Water Reactor

BRITAIN'S first large heavy water reactor DIDO, which has been built for testing materials and making powerful radioactive isotopes, is now in operation at Harwell. The last fuel element which brought the loading to the critical amount was inserted by Sir John Cockcroft, Director of the Atomic Energy Research Establishment, on 7th November.

DIDO will develop about 10 MW of heat at full power, and its neutron flux will be about 10^{14} neutrons/sq cm/sec. It is the most powerful experimental reactor in Western Europe. Heavy water is used as the moderator which slows down the speed of neutrons and the fuel is highly enriched uranium. The reactor will be formally opened by the president of the Royal Society, Sir Cyril Hinshelwood, on 21st November.

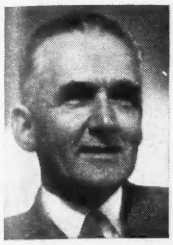
Public Transport Association

THERE was a large assembly at the annual dinner of the Public Transport Association, which was held on 8th November at Grosvenor House, London. Mr. J. M. Birch (chairman) presided, and the principal guest was Lord Brabazon, who proposed the toast of the Association.

Lord Brabazon said that the Association was a well organised entity speaking with one voice on the various matters affecting public transport. He referred to its great responsibilities in providing a service of national importance. He was critical of the Government's proposals to provide a revenue subsidy for the railways.

Mr. Birch, in responding, said that members of the Association found themselves in the position of operating an ever-increasing number of unremunerative services, especially in rural areas. He referred to the heavy burden of special taxation carried by the bus industry. The tax on diesel fuel used in road vehicles was now 2s 6d per gallon, an average burden of 3d for every bus mile run, which cost the bus industry some £30 million a year. The Association considered this unfair when industry generally, including their competitors, the railways, were allowed to use the same fuel tax free. The White Paper clearly indicated that the Government subsidy would be used by the railways to keep fares at an artificially low level and free enterprise bus and coach operators would therefore find themselves competing with a subsidised nationalised undertaking. Mr. Birch followed his response by proposing the toast to the guests, to which Lord Derwent (chairman, British Road Federation) replied.

At the dinner copies of letters sent by the Association to the Chancellor of the Exchequer and the Minister of Transport and Civil Aviation were distributed to the Press. The letter to the Chancellor refers to the unfairness of the tax on fuel oil for vehicles when the railways, which have an extensive programme of diesel vehicles, are exempt, and it appeals for the abolition of the duty. The letter to the Minister of Transport also refers to the "extortionate duty of 2s 6d per gallon" on fuel used in road passenger transport vehicles and says that the proposed revenue subsidy to the railways inevitably means subsidised competition.



Mr. F. G. Bennett

Mr. J. W. Macfarlane

Mr. J. L. Griffiths

Mr. E. H. Scholes

Mr. F. W. Allan

Mr. R. B. Anderson

I.E.E. Sub-Centres

CHAIRMEN FOR THE 1956-57 SESSION

Mr. J. A. Sumner

WE have already published biographical details and the portraits of the chairmen of the Specialised Sections and of the Provincial Centres of the Institution of Electrical Engineers, and we now give below similar information regarding the chairmen of some of the Sub-Centres of the Institution, and propose to deal similarly with the remainder in a following issue.

Mr. R. B. Anderson, M.I.E.E., M.Am.I.E.E. (North Scotland), who was appointed manager of the Dundee Area of the North of Scotland Hydro-Electric Board earlier this year, has been associated with Scottish electricity supply since 1930. After receiving his technical education at the Royal Technical College, Glasgow, he joined the Scottish Central Electric Power Co. in 1930 as substation engineer. In 1933 he was appointed technical assistant and meter superintendent with the Grampian Electricity Supply Co., and in 1939 became distribution superintendent in charge of auxiliary steam generating stations with that company. He joined the North of Scotland Hydro-Electric Board in 1947 as area engineer, South Caledonia Area, later becoming deputy area manager and distribution engineer, and in 1951 took up the position of manager of the Northern Area of the Board.

Mr. F. G. Bennett, Assoc.M.C.T., M.I.E.E., M.I.Mech.E. (South East Scotland), received his technical training at Manchester College of Technology through a day course scholarship awarded by the Metropolitan-Vickers Electrical Co., Ltd., with which company he served his apprenticeship and subsequently held various positions up to chief textile engineer. He is now deputy managing director of Wm. Allan Smith & Co., Ltd., Edinburgh.

Mr. J. W. Macfarlane, Ph.D., Wh.Sen.Sch., F.R.S.E., M.I.E.E., M.I.Mech.E., J.P. (South West Scotland), is managing director of the Macfarlane Engineering Co., Ltd., and Milholm, Ltd. He was educated at Allan Glen's School and the Royal Technical College, Glasgow, and received his training with the Macfarlane Engineering Co., with whom he subsequently held the positions of draughtsman (1930), chief engineer (1937), director (1940) and secretary (1942); he became managing director in 1954. He has been a county councillor of Renfrewshire since 1943 and is a governor of the Royal Technical College, Glasgow.

Mr. J. L. Griffiths, A.M.I.E.E. (West Wales (Swansea)), is manager of the Swansea office of the English Electric Co., Ltd. He received his education at the Bradford Technical College and the Birmingham College of Technology, and after completing a four-year apprenticeship with the English Electric Co., Ltd., he spent four years on motor test followed by two years' commercial work on sales and contracts. In 1930 he was appointed changeover engineer and was in charge of the changeover in Birmingham and the Midlands, and subsequently in South Wales. Later he joined the company's Cardiff office staff, and in 1940 took charge of the company's first office to be opened in Swansea. He has completed thirty-six years' service with the English Electric Co. Mr. Griffiths is a Fellow of the Association of Mining Electrical and Mechanical Engineers and is vice-president (and a former president) of the West Wales Branch of the Association.

Mr. E. H. Scholes, A.M.I.E.E. (North Lancs.), was educated at Ackworth School, Yorks., and served as a part-time student at the Huddersfield Technical College; his practical training was received with the Huddersfield Corporation Electricity Department, with which he later became constructional assistant. In 1940 he became constructional assistant to the city electrical engineer at Lancaster power station, supervising extensions to that station. He was appointed deputy station superintendent at Lancaster in 1942, becoming station superintendent in 1947.

Mr. F. W. Allan, A.M.I.E.E. (Tees-Side), has spent the whole of his career in the Post Office Engineering Department. He was educated at West Leeds High School and joined the Post Office Engineering Department in Leeds as a youth-in-training in 1914. After service with the Royal Engineers in the 1914-18 war he returned to the Post Office and worked on the installation and maintenance of automatic telephone exchanges in Leeds and Halifax for several years, during which he specialised in the tracing and suppression of electrical interference with radio reception in the West and East Ridings. Later he supervised the construction of external line plant for P.O. telephone services and the installation of subscribers' station apparatus in Leeds and West Yorkshire. He was appointed assistant area engineer at Middlesbrough in 1942 and became engineer in charge of the Engineering Division of the Middlesbrough telephone area in 1952. He has lectured on telephone engineering subjects at the Leeds College of Technology and the Constantine Technical College, Middlesbrough.

Mr. J. A. Sumner, M.I.E.E., M.I.Mech.E., F.I.I.A. (East Anglian), is manager of the Norfolk Sub-Area of the Eastern Electricity Board, Norwich. After studying at the University College, Nottingham, he joined the Derby & Notts. Power Co. in 1922 as a junior engineer. Three years later he became chief assistant with the Mid-Cheshire Power Co., and in 1930 was appointed chief distribution engineer with the West Midlands Joint Electricity Authority. He was appointed city electrical engineer at Norwich in 1940, and held this position until nationalisation in 1948.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. F. J. Erroll, M.A., M.I.E.E., who has been Parliamentary Secretary to the Ministry of Supply since April, 1955, has succeeded Mr. D. Walker-Smith as Parliamentary Secretary to the Board of Trade.

Mr. P. H. Spagnoletti, O.B.E., B.A., M.I.E.E., has been appointed component group manager of Standard Telephones & Cables, Ltd. Mr. Spagnoletti was formerly general manager and a director of Kolster-Brandes, Ltd., and for three years chairman of the British Radio Equipment Manufacturers' Association. He will control all divisions of S.T.C. concerned with Brimar and S.T.C. receiver valves, transmitter valves, c.r. tubes, semi-conductors, rectifiers, crystals, magnetic materials, condensers, etc.

Mr. P. H. Spagnoletti

Mr. Spagnoletti graduated at Trinity College, Cambridge, and joined Standard Telephones & Cables, Ltd., in 1929, first working on high-power short-wave transmitters on the transatlantic telephone link and ship-to-shore transmitters. In 1932 he took charge of the planning, installation and testing of the first two Daventry Empire broadcasting stations, and in 1934 went to the Far East to assist in establishing telephone circuits between Shanghai, Tokio, London and New York. On return to Europe in 1937 he travelled considerably on the technical sales side of civil aviation radio. Later he was in charge of aviation development work in the S.T.C. radio division, and in 1945 became chief engineer to Kolster-Brandes, Ltd., and finally general manager and a director of that company.

The Copley Medal has been awarded by the Royal Society to **Professor P. M. S. Blackett,** F.R.S., professor of physics at the Imperial College of Science and Technology, London, for his outstanding studies of cosmic ray showers and heavy mesons and in the field of palæomagnetism.

To commemorate his fifty years' service with Falk, Stadelmann & Co., Ltd., **Mr. Charles W. Symmonds,** local director controlling the Irish branch, was presented with a television set by Mr. Cecil J. Falk, director of the company, who presided at a recent staff dinner in the Central Hotel, Dublin. A presentation was also made to Mr. Symmonds by Mr. Kevin Maher on behalf of the staff. Mr. M. J. O'Connor, director/secretary of the Society of Irish Electrical Traders, paid a tribute to Mr. Symmonds who is a founder-member of the Society, a past president, and for the past fourteen years hon. treasurer.

Siemens-Ediswan, Ltd., announces the appointment of **Mr. C. W. W. Torrance** as manager of Siemens Brothers & Co., Ltd., in Northern Ireland. This appointment is additional to his present duties as manager of the Edison Swan Electric Co. in this territory. **Mr. D. M. Head** has been similarly appointed manager of the Edison Swan Electric Co. in the Republic of Ireland in addition to his present duties as manager of Siemens Brothers.

Mr. Eric Bylund has been appointed managing director of Sunbeam Electric, Ltd. Mr. Bylund, who is Swedish by birth, has been associated with the Sunbeam Corporation of Chicago for many years.

Mr. R. Walker, who has been a managing director, and latterly the technical director, of the Universal Asbestos Manufacturing Co., Ltd., since its inception as a public company, retired from the board on 20th October. His association with the company will continue, however, in the capacity of technical consultant.

Mr. E. Long, F.C.I.S., secretary of the Central Electricity Authority, has been elected a vice-president of the Chartered Institute of Secretaries for the year commencing 1st January next.

At the annual meeting of the Incorporated Sales Managers' Association held on 8th October, **Lord Woolton** was elected president for the ensuing year and **Mr. E. C. Lee** was elected chairman.

The following new appointments to the managerial staff are announced by Cryselco, Ltd.:—

Mr. F. J. Burns, who is at present manager of the Liverpool branch, becomes assistant sales manager of the company. He received his early training in the electrical contracting industry and joined Cryselco as a sales representative in 1941 and was appointed Liverpool branch manager in 1952. He was a founder member of the Merseyside Electric Lighting Services Committee, is a member of the E.I.B.A. local committee and is this year's chairman of the Liverpool Centre of the Illuminating Engineering Society.

Mr. F. J. Burns

Mr. N. B. W. Castleton

Mr. R. J. Bass

Mr. N. B. W. Castleton, who is at present the Cardiff branch manager, will take over the Liverpool branch from Mr. Burns. He joined the company in 1946 as sales representative in the Bradford/Hull area, becoming Cardiff branch manager in 1953.

Mr. R. J. Bass, who is senior representative in South Wales, succeeds Mr. Castleton as manager of the Cardiff branch. He has been with the company for over ten years in the South Wales area.

In our last issue we reported the appointments of **Mr. S. R. Eade,** M.I.E.E., as sole managing director of the A.E.I. Lamp & Lighting Co., Ltd., and of **Mr. J. Clement,** B.Sc., as sales director. We now reproduce their portraits.

Mr. S. R. Eade

Mr. J. Clement

Following the departure of **Mr. J. Mackie** to join the board of Parnall (Australia) Pty., Ltd., **Mr. R. S. Martin,** A.A.C.C.A., and **Miss D. Johnson,** A.C.I.S., have been appointed joint secretaries of Parnall (Yate), Ltd., and Ascot Gas Water Heaters, Ltd., with effect from 1st November.

Mr. Kenneth Wood, managing director of the Kenwood Manufacturing Co., Ltd., left on the *Queen Mary* on 8th November for a business tour of the United States.

Mr. W. O. Hirst has been appointed chief engineer of the John Bright & Brothers, Ltd., group of mills, including those of

the subsidiary company, James Stott, Ltd., Oldham. Mr. Hirst, who succeeds the late Mr. J. H. Sutcliffe, has been with John Bright & Brothers for nine years.

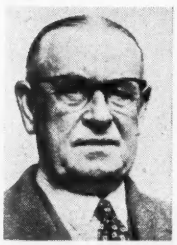
Sharples Centrifuges, Ltd., announces the appointment of **Mr. F. A. Cullum** as its marine sales manager. Mr. Cullum joined Sharples in 1923 and has been responsible for all marine sales in Great Britain and Northern Ireland.

Mr. D. D. Jones, M.Sc., D.I.C., who writes in this issue on "Junction Transistor Circuits," graduated from the University College of Wales, Aberystwyth, in 1943 and then served as a radar officer in the Royal Air Force. He joined the Research Laboratories of the General Electric Co., Ltd., in 1947 to work on the London-Birmingham radio relay television link. In 1951 he went to the Imperial College for post-graduate study in electrical engineering and on returning to the G.E.C. he joined the Semi-Conductor Department. He is now in charge of the group working on the evaluation and application of semi-conductors.

Mr. D. D. Jones

The annual dinner and dance of the **I.E.E. Southern Centre** will be held on 13th December (7 for 7.30 p.m.) at the Polygon Hotel, Southampton. Tickets, 27s 6d each (students 15s each), can be obtained from Mr. C. G. Brammer, Southern Electricity Board, Magdalen Road, Portsmouth. Applications should be made by 3rd December.

Mr. J. E. Forster has retired from the position of works manager at the Fraser & Chalmers Engineering Works, Erith, of the General Electric Co., Ltd., after thirty-one years' service with the company. Mr. Forster went to Erith in 1925 and was employed at first in the Estimating Department. He successively held appointments as chief of progress and assistant works manager, before being appointed works manager in 1939, when he was responsible for adapting the plant to war-time production. This position he held until his retirement on 30th September.



Mr. J. E. Forster

For many years Mr. Forster represented the company's interests in the affairs of the Engineering and Allied Employers' Association, of which he is a vice-president, and in 1953 was appointed by that body to the General Council of the National Federation. A member of the local employment committee, Mr. Forster also became a referee on the local appeals board. He is succeeded as works manager at Erith by **Mr. S. W. Hyde,** hitherto production manager.

By Order-in-Council dated 31st October the Department of Scientific and Industrial Research Act, 1956, came into force on 7th November. Members of the new Council include **Professor P. M. S. Blackett,** M.A., D.Sc., F.R.S. (professor of physics, Imperial College of Science and Technology, University of London), a member of the former Advisory Council, and **Mr. Willis Jackson,** D.Sc., D.Phil., M.I.E.E., M.I.Mech.E., F.R.S. (director of research and education, Metropolitan-Vickers Electrical Co.).

As a result of its recent production of "Book of the Month" at the Cripplegate Theatre, the **G.E.C. Dramatic Society** has donated £50 to the National Spastics Society.

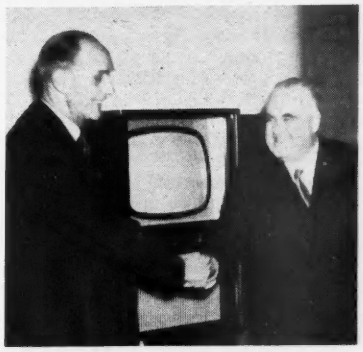
Mr. J. E. Tonge has been appointed northern area manager for Courtney, Pope (Electrical), Ltd., and will be in charge of the company's new showrooms in Manchester, the opening of which was referred to in our "Industrial News" section last week. Mr. Tonge has been with the company for some years and has spent his business life in the electrical and lighting industry.

Mr. J. E. Tonge

Mr. H. G. Smith has retired from the Benjamin Electric, Ltd., with whom he has been in charge of the Rolling Department in the press shop since 1915; he joined the company in 1915. Mr. H. G. Campbell, joint managing director, recently presented Mr. Smith with a portable radio set and a cheque.

Mr. Percy Spencer has completed fifty years' service with W. J. Furse & Co., Ltd., and to mark the occasion he has been presented with a cheque from the directors (presented by Mr. S. J. Furse, chairman and managing director), and a television set by the employees (presented by Mr. N. C. Slater, general manager of the contracts section). A party was held recently in Mr. Spencer's honour.

Mr. J. S. Dryden, secretary of the Hackbridge & Hewittic Electric Co., Ltd., has retired after thirty-six years' service. After joining the Hackbridge Electric Construction Co. as accountant in 1920, Mr. Dryden became secretary in 1942 and was appointed



Mr. A. M. Browne (chairman and managing director of the Hackbridge & Hewittic Electric Co.) making a presentation to Mr. J. S. Dryden on his retirement

secretary of both Hackbridge Electric Construction Co. and Hewittic Electric Co. upon their amalgamation in 1947. To mark the occasion he has been presented with a television set on behalf of his colleagues by Mr. A. M. Browne, chairman and managing director. Mr. Dryden is succeeded by **Mr. E. P. Jones,** previously assistant secretary.

Mr. A. L. G. Lindley, general manager of the Fraser & Chalmers Engineering Works of the General Electric Co., Ltd., and a director of that company, was the guest speaker at last Tuesday's luncheon of the **Electrical Industries Club.** His theme was the impact of nuclear power on the electrical engineering industry and he gave an interesting account of the operation of nuclear reactors and the problems involved. Mr. Leslie Gamage (president) was in the chair, and announced that the next function would be the Christmas luncheon on 11th December. He also mentioned that a cup presented at the Club's golf competition was won by Mr. R. W. Holledge and that the Club had contributed 25 guineas to the Lord Mayor's fund for Hungary. A vote of thanks to the speaker was proposed by Mr. W. J. Jones.

Mr. C. W. Badcock, head foreman of the coil winding shop of Oliver Pell Control, Ltd., has retired from this position, but he will continue with the company as personnel adviser. At a lunch party recently Mr. G. F. N. Oliver presented him with a v.h.f. radio set on behalf of the company. Mr. Badcock joined Oliver Pell in 1913, and has been head foreman of the coil winding shop for the past twenty-six years.

Mr. C. W. Badcock

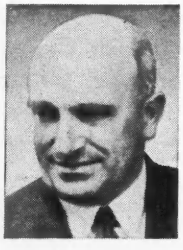
Mr. Michael Clear, sales director of the Brush Group, Ltd., left by air for New York on 9th November.

The retirement is announced of **Mr. Dilwyn Williams,** Associate I.E.E., the district engineer in the Rhondda area of the South Wales Electricity Board, after more than forty-two years' service with the electricity supply industry. Before nationalisation he had devoted his entire service to the former Rhondda municipal undertaking, finally becoming its deputy electrical engineer. At vesting date he was appointed to his present position. He will be succeeded as district engineer by **Mr. A. C. Davies,** M.C., Graduate I.E.E., who has been district engineer, Abergavenny and Monmouth/Chepstow, for the past seven years.

Mr. E. W. Jones, manager of the Central Sub-Area of the South Wales Electricity Board at Cardiff, will retire on 31st December. He was appointed one of the four sub-area managers of the Board at vesting date and after serving first as sub-area manager of the Eastern Sub-Area he was appointed manager of the Central Sub-Area in 1953. In all Mr. Jones has spent more than fifty years in the service of the electricity supply industry. After service at the generating plants of the Coed Ely and Albion Collieries he was appointed in 1918 as manager and chief electrical engineer of the former Mountain Ash municipal undertaking, a position he held for thirty years.

Consequent on Mr. Jones' retirement, the following appointments are announced with effect from 1st January next:—Central Sub-Area manager: **Mr. C. L. Townsend,** Associate I.E.E. Mr. Townsend has been Eastern Sub-Area manager for the past three years. He was previously Western Sub-Area manager. Before nationalisation he was the engineer and manager of the former West Cambrian Power Co. and its associated companies in West Wales. Eastern Sub-Area manager: **Mr. D. G. Gwyn,** B.Sc., A.M.I.E.E. Mr. Gwyn is at present Western Sub-Area manager. At vesting date he was the electrical engineer and manager of the former Barry municipal undertaking and before his present appointment he was an assistant chief commercial officer of the Board. Western Sub-Area manager: **Mr. W. E. Richardson,** A.M.I.E.E. Mr. Richardson, who succeeds Mr. Gwyn as Western Sub-Area manager, is at present sub-area engineer in the Board's Eastern Sub-Area. Before vesting date he held successive engineering appointments with electricity undertakings at Shoreham, Southampton, Norwich and Newport (Mon.). He was appointed to his present position in 1949.

Mr. E. W. Jones



Mr. C. L. Townsend

Mr. D. G. Gwyn

Mr. W. E. Richardson

Mr. Donald Campbell addressing the assembly at the English Electric apprentices' presentation. Seated in the front row (left to right) are Mr. F. C. Keeling (foreman), Mr. J. R. Sully (general manager, Stafford), Mr. B. J. Tams (chief of education and personnel), and Mr. J. K. Brown (director of research)

In presenting "The Holly and the Ivy," by Wynyard Browne, on 8th and 9th November at the Portland Hall, London, **The Portland Players** (the dramatic section of the Central Electricity Authority Sports and Social Club) gave what were probably their best performances to date. This well-known play is set in a country vicarage at Christmas time, and the action is centred on the vicar whose elder daughter's sense of filial duty almost wrecks her romance with a young Scottish engineer, while the vicar's younger daughter has had a tragic love affair which has left her without interest in life. As the Rev. Martin Gregory, James Rintoul gave an outstanding performance, and Gladys Feast (as Jenny, the elder daughter) played the part with feeling. Antony Moss as David Paterson, the young Scottish engineer, might well have come from Aberdeen (his accent was perfect). Angela Davis as Margaret (the vicar's younger daughter) successfully conveyed an air of personal tragedy and the big scene with her father was skilfully played. The supporting roles by Ian Clarke (Mick, the vicar's son), Monica Owen (Aunt Bridget, the vicar's sister), Marjorie James (his sister-in-law) and Richard Wyndham (as uncle) were also well drawn.

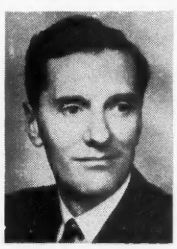
On 9th November craft and student apprentices of the **English Electric Co., Ltd.,** were presented with indentures and awards. The presentations were made by Mr. Donald Campbell at the Borough Hall, Stafford, in the presence of a number of English Electric executives.

Mr. C. F. Wells, M.I.Mech.E., has been appointed manager, Gear Engineering Department, of the British Thomson-Houston Co., Ltd., Rugby, in succession to **Mr. S. A. Couling,** M.I.Mech.E., A.M.I.C.E., who relinquished the appointment on 31st October in order to devote his full time to special problems of production for the company. Mr. Wells joined the company in 1930, after ten years (first as apprentice, then as draughtsman) with mechanical engineering concerns in the North of England. In 1934 he was posted to the Turbine Engineering Department, and in 1949 became chief assistant to Mr. Couling in the Gear Engineering Department.

Mr. C. F. Wells

Mr. M. B. Henderson, who has been technical manager of the company for the past six years, has been elected to the board of the Universal Asbestos Manufacturing Co., Ltd., and **Major-General Sir John Sinclair,** K.C.M.G., C.B., O.B.E., has also been elected to the board.

Mr. E. G. Spearing has been appointed general manager, sales, with Brown Brothers, Ltd. In 1946, after war service in the R.A.F. with the rank of squadron leader, Mr. Spearing joined Brown Brothers as a representative at Nottingham Branch. He has served the company in various capacities, including assistant district manager at Edinburgh branch, and assistant sales



Mr. E. G. Spearing

manager, London, becoming sales manager in 1952. **Mr. J. W. Franks** has been appointed manager, London sales. He has been with the company since 1929 with the exception of war service. He became a representative in 1945 on return from active service, and was subsequently appointed sales supervisor.

The annual ball of the Sussex Centre of the **Electrical Industries Benevolent Association** will be held on 25th January at the Grand Hotel, Brighton. Tickets are 30s each and can be obtained from Mr. T. H. Batchelor, hon. secretary, 10, Queen's Gardens, Hove, 3.

On Tuesday last week the annual dinner of the **Lightmongers** was held at the Old Red House, Bishopsgate, London, E.C, when 87 members and guests were present. After the loyal toast had been proposed by the president (Mr. T. S. Jones), Mr. L. A. Fickling proposed the health of the society which, he said, was an association of business men with one common interest—lighting—and whose purpose was purely social. During the year there had been a 50 per cent increase in membership, to 67.

The president responded very briefly and Mr. J. Woods proposed the toast of the guests to which Mr. R. Wiseman (A.E.I., Sydney, N.S.W.) replied. Mr. Wiseman regretted that import restrictions prevented him from selling as many British products in Australia as he would like but he assured the company that on his return he would "sell" Great Britain to his countrymen.

Mr. H. W. Hall spoke very appreciatively of the president in proposing his health and, in replying, Mr. Jones described the society as the brainchild of Messrs. M. A. Millar and V. G. E. Gardner. He said that it would never be a commercial body. A large proportion of its revenue was devoted to charitable objects and he had great pleasure in handing a cheque for £30 to Mr. H. F. Wickham, representing the E.I.B.A. Mr. Wickham expressed his Association's gratitude to the Lightmongers for their gift and then Mr. Jones invested his successor, Mr. H. W. Hall, with the presidential badge of office.

Mr. T. S. Jones invests his successor, Mr. H. W. Hall, with the president's badge

The evening concluded with a reunion of members and guests. Mr. S. Anderson is the new vice-president.

OBITUARY

Mr. J. Henderson.—The death occurred on 21st October at the age of fifty-four of Mr. J. Henderson, B.Sc.(Eng.), A.M.I.E.E., for many years with British Insulated Callender's Cables, Ltd. Mr. Henderson was educated at the Freemason's School, Watford, and joined the former Callender's Cable & Construction Co., Ltd., in 1919 in their Technical Department at Erith. After the formation of B.I.C.C. in 1945 he held several senior posts, becoming assistant chief engineer, power cables and later power cables engineer directly responsible to the director of production and engineering, being mainly concerned with submarine power cable projects.

The late Mr. J. Henderson

Mr. Henderson served on various Cable Makers' Association technical committees. He had been occupied throughout his career with the study of raw materials for cable making, their manufacture and behaviour under operational conditions.

Mr. W. C. R. Lindley.—The death occurred on 7th November, of Mr. Winston Cecil Robert Lindley, aged 56, first assistant district engineer with the South West Fylde District of the North Western Electricity Board. Mr. Lindley had lived in Lytham St. Annes all his life and commenced his career with the former Lytham St. Annes Corporation undertaking, and, at the time of nationalisation, was mains superintendent to that authority.

Mr. J. A. Lee.—The death occurred on 9th November at his home at Bromley, Kent, of Mr. John Andrew Lee, O.B.E., M.I.E.E., A.M.I.Mech.E., transmission consultant to British Insulated Callender's Construction Co., Ltd. Mr. Lee was born in London in 1883. He entered the electricity supply industry as a trainee at Ilford electricity works and from 1906 to 1912 was a charge engineer at Stepney. During the 1914-18 war he served in the Royal Engineers and afterwards was personal assistant to Sir John Snell, chairman of the Electricity Commission for about a year. He was an assistant engineer with the Commission from 1920 to 1928 and then construction engineer with the Central Electricity Board from 1928 to 1948 and in the following year was appointed transmission consultant to B.I. Callender's Construction Co. Mr. Lee was made an O.B.E. in the 1949 New Year Honours List. He was chairman of the Transmission Section of the I.E.E. in 1946-47.

Mr. P. V. Hunter.—A large and representative gathering of the electrical profession and industry attended the memorial service to the late Mr. P. V. Hunter, which was held on 8th November at St. Margaret's, Westminster. The Rev. Dr. E. G. Jay officiated. The lesson was read by Mr. W. H. McFadzean (chairman and managing director, British Insulated Callender's Cables, Ltd.), and an address was given by the Rev. Cyril Cresswell (chaplain to the Council of the Institution of Electrical Engineers).

In addition to Mrs. Hunter (widow) and other members of the family, the congregation included the directorate of British Insulated Callender's Cables, Ltd., representatives of subsidiary companies and members of the staff, Sir Gordon Radley (President of the Institution of Electrical Engineers) and members of the Council, Lord and Lady Citrine, and a large number of prominent men representing the electrical manufacturing industry, institutions and trade associations.

WILLS

Mr. J. W. Rodger, M.I.E.E., managing director of Bruce Peebles & Co., Ltd., who died on 16th August, left personal estate in England and Scotland valued at £13,004.

Mr. E. B. Wedmore, C.B.E., M.I.E.E., F.Inst.P., first director and secretary of the British Electrical and Allied Industries Research Association, who died on 16th June last, left £2,165 gross (£1,994 net).

Mr. J. Entwistle, A.M.I.E.E., a director of H. J. Baldwin & Co., Ltd., and of Mersey Cable Works, Ltd., who died on 4th July, left £9,915 gross (£9,608 net).

Mr. R. W. L. Phillips, M.I.E.E., of Clairville, Roxton Road, Great Barford, Beds, formerly for over thirty-five years borough electrical engineer at Bedford, who died on 2nd July last, left £231.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £285 5s 0d
Fire Refined 99·7%	ton £284 0s 0d
Fire Refined 99·50%	ton £283 0s 0d
COPPER Tubes ..	lb 2s 9½d
Sheet	ton £356 0s 0d
H.C. wire and strip ..	ton £320 10s 0d
LEAD, English ..	ton £119 10s 0d
Foreign	ton £118 0s 0d
MERCURY	flask £83 10s 0d
TIN, block (English) ..	ton £844 0s 0d
ZINC, G.O.B. Foreign	ton £101 5s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 3½d
Sheet	ton —
Wire	lb 2s 11½d
PHOSPHOR BRONZE Wire	lb 4s 5½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 31d—31½d

PARLIAMENTARY REPORT

THE effect on oil supplies of the war in the Middle East and the sinking of blockships by the Egyptians to stop up the Suez Canal were reported to the House of Commons last week by the Minister of Fuel and Power (Mr. Aubrey Jones). He said that as a precautionary measure the oil companies were being required to reduce deliveries to their customers forthwith to 90 per cent of what they would normally have supplied. Besides the 10 per cent cut in motor fuels, deliveries of fuel oil, gas oil and diesel oil were also being cut by 10 per cent. This would affect supplies to industry and also the use of these oils for heating; the only exceptions would be agriculture, fishing and essential coastal shipping and buildings like hospitals where special considerations arose. The gas and electricity industries were being asked to make bigger savings and reduce their requirements of oil to the maximum extent possible without affecting their production.

Mr. Nabarro said a large number of firms had switched over entirely to the use of oil fuel for industrial power purposes in response to the Government's policy. Could the Minister give assurances that firms which were entirely reliant upon oil fuel would receive some preferential treatment?

Mr. Jones said that what he had described was a rough and ready measure. It did not amount to a formal rationing or a formal licensing scheme. But, granted its character, there could be no exceptions other than those which he had stated.

Mr. Hobson asked whether the Minister had consulted the Minister of Transport about the cut in oil, particularly to the power station at Neasden belonging to the London Passenger Transport Board. In view of the fact that at least eight of the boilers were run on oil fuel, would a special arrangement be made?

Mr. Jones said he had had general consultations with the Minister of Transport. This was a voluntary restriction and was dependent, therefore, to a great extent on co-operation. For that reason only a very limited number of exceptions were being made and he could not add to those he had detailed.

Electricity Supply Reorganisation

In the debate on the Government's programme in the House of Lords, the Earl of Selkirk, Chancellor of the Duchy of Lancaster, said the Government had carefully considered the recommendations of the Herbert Committee and the Bill referred to in the Queen's Speech would be based largely on the Committee's report. It was the outcome of the first full-scale review of a nationalised industry ever carried out by an independent committee. It was appropriate that the alterations in the structure of the electricity supply industry should come at a time when the first nuclear power station had come into operation.

Lord Lucas of Chilworth said the Herbert Report was a critical one; it said that those in the electricity supply industry had not done as much hard thinking about the economics of the business as they should have done. He had a feeling that the day would come when it would be found that millions of pounds had been wasted. He had already suggested that the Government should have an inquiry to see whether it was necessary to have a huge grid which ruined the amenities of millions of people in the countryside. Perhaps the Government ought also to have an inquiry into the hydro-electric schemes in Scotland to consider whether the money spent on damming the watersheds had been wasted. "I think that in the years to come the whole outfit will be found a dead loss," he declared. He regretted that the terms of reference of the Herbert Committee had not extended to the archaic methods adopted for consulting the citizens whose amenities were desecrated by overhead lines. Perhaps more would be heard on this subject when the Oliver Franks Committee reported to Parliament; but the public inquiry system relating to the activities of the C.E.A. was a disgrace to any country which called itself a democracy.

Ex-Local-Authority Pensioners

Mrs. Castle asked the Minister of Fuel and Power whether he had yet considered an application from the Central Electricity Authority for his approval to proposals for increases in the pensions of ex-local-authority pensioners for whom the Authority has become liable under the Electricity Act, 1947.

Mr. David Renton, Parliamentary Secretary, said the Minister had not yet received an application.

Nuclear Power Programme

The Minister of Fuel and Power said on Monday last that he hoped to announce more precisely by the end of the year a revision of the nuclear power programme.

Telecommunication Engineers' Dinner

WHAT the Post Office has done and what it intends doing in the sphere of telecommunications were outlined last week by the Postmaster-General when he proposed a toast to the telephone industry at the annual dinner of the Telecommunications Engineering and Manufacturing Association on 8th November. He said that at present there were 7,065,000 telephones in the country and by 31st March, 1959, more than 8 million would be connected. Orders for new equipment were being placed at the rate of £15 million a year compared with £10½ million in 1954. With Treasury permission the additional investment rate for next year was likely to be at least £16 million.

During the past year the Post Office had opened 243 new telephone exchanges and extended many others. About 100 new exchange buildings or extensions were being started this year, compared with 70 in 1955 and 47 in 1954. By the end of this year 1,200 new trunk circuits would be operating as compared with a year ago. The traffic on the transatlantic telephone cable had risen by nearly 100 per cent with America and nearly 200 per cent with Canada. If this continued, the cable would "break even" much sooner than anticipated.

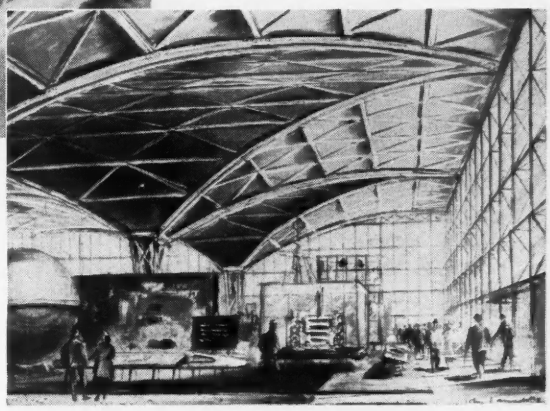
In reply, Sir Thomas Spencer, chairman and managing director of Standard Telephones & Cables, Ltd., and chairman of the Association, expressed the appreciation of the industry that the Postmaster-General had advised increased expenditure on telephone equipment and building. He also referred to the recent joint development and research committee which had been set up between industry and the Post Office so that a common effort might be made towards the introduction of new and up-to-date electronic telephone exchanges in this country and in the British export field. Sir Thomas stressed that the Post Office and the industry had been together for a very long time in handling the complex problems of providing the country's telephone service, and that the new electronic age could be, and would be adequately faced up to by the manufacturers.

The toast "Our Guests" was proposed by Sir William Morgan, and Sir Godfrey Ince, who attended in place of the Rt. Hon. A. R. W. Low, replied briefly.

Modern H.V. Switchgear

We regret that there were two errors in the report on Mr. Parry's I.E.E. address as chairman of the Northern Ireland Centre in last week's issue (page 882). The figure of 1,000 MVA in the fourth line should read 10,000 MVA, while the later reference to lead-tank breakers should read dead-tank.

PLANS FOR THE BRITISH ELECTRICAL DISPLAY



Brussels Exhibition 1958

Artist impression's of the British Industrial Pavilion in the Brussels Exhibition—exterior and interior. The inside view shows the roof construction and glazed walls

FURTHER particulars of the Brussels Universal and International Exhibition (17th April to 19th October, 1958) were given at a Press conference last week by Mr. D. Maxwell Buist, export director of the British Electrical and Allied Manufacturers' Association, and Mr. Sam Black, head of the Association's Publicity Department.

Plans were displayed showing that the area allocated for the Exhibition measures some two miles by one mile and that the national sections roughly follow a geographical pattern. The space taken by the United Kingdom is said to be in a convenient and accessible position and on it there will be two main buildings—a Government Pavilion and a British Industrial Pavilion. The constructional work is to begin immediately; it will be inaugurated by Sir John Balfour, the United Kingdom Commissioner-General for the Exhibition, next Tuesday.

The Industrial Exhibition is being organised by the F.B.I. subsidiary, British Overseas Fairs, Ltd., to represent the leading British industries, and the electrical engineering exhibit will occupy a substantial part of the 60,000 sq ft covered by the pavilion. An artist's impression of the exterior of this pavilion and an internal view showing the general construction are reproduced. It will be seen that the walls are mainly of glass; this will enable visitors to see much of the display at night after the pavilion has been closed.

It is intended that the electrical section shall tell the story of this country's contribution to the advancement of the generation, distribution and application of electricity in all fields, industrial and domestic, in transport, communications and so on. Possible future developments will be demonstrated and no doubt much will be made of Great Britain's pioneer work in the generation of electricity from nuclear energy.

While the B.E.A.M.A. has undertaken the responsibility for organising the electrical exhibit other associations and non-member firms have been invited to take part and several have already accepted the invitation, for instance the Water Tube Boilermakers' Association, the Cable Makers' Association, the Radio Communication and Electronic Engineering Association, the Telecommunications Engineering and Manufacturing Association and the Electric Light Fittings Association.

The fourth edition of the B.E.A.M.A. Catalogue will be available at the Exhibition and there will be a well-equipped technical information office in which participating associations and firms will be able to display their catalogues and other literature.

Sufficient funds have been guaranteed to enable the electrical exhibit to be proceeded with but further financial and other assistance is needed to ensure that the display shall be fully representative and, if possible, better than comparable exhibits arranged by this country's competitors in the world's electrical markets. Full particulars of the plans for the electrical section can be obtained from Mr. Sam Black at 36-38, Kingsway, London, W.C.2.

Electrical Association for Women

Miss Mary George, M.B.E., the recently appointed director and secretary of the Electrical Association for Women, and members of her staff were "at home" to Press representatives at the Association's headquarters, 25, Foubert's Place, London, S.W.1, on Friday last week.

In a brief address Miss George gave her views on the place of women in modern society and affirmed her faith in electricity as a means of enabling women to play a greater part in local and national affairs. She spoke of the work which the E.A.W. had done in educating women in the uses of electricity and in assisting designers and manufacturers to meet their needs, and made particular reference to the Association's "Planning for Light" campaign which was culminating in a public meeting at the Institution of Electrical Engineers on 21st November.

Mrs. Pickford then spoke in more detail of the work of the E.A.W., especially in the testing of appliances in actual use and the provision of confidential reports to manufacturers suggesting improvements. She extended an invitation to all to make periodical visits to Foubert's Place to see the latest ideas in domestic electrical development.

Babcock

Automatic welding of studs on tubes

ABUNDANT testimony to the ability of British electrical and allied manufacturers to meet all engineering requirements in the construction and equipment of nuclear power stations as an expansion of their normal activities is notably exemplified by Babcock & Wilcox, Ltd., at their Renfrew works, which we visited last week.

Although recent extensions there are now occupied largely with the production of hitherto orthodox high-pressure boiler plant, which will for many years be needed in progressively advancing designs, they are laid out on a sufficiently flexible basis to cope with a prospective change in large measure from coal or oil to nuclear fuel.

The most obvious indication of this tendency is the heat-exchanger sections for the Chapel Cross station of the Atomic Energy Authority at Annan in Scotland. These are in succession to the units built for Calder Hall " A " (described fully with illustrations in the *Electrical Review* of 19th October) and for Calder Hall " B."

A logical step from the production of heat exchangers, the steam-raising component, is the provision of reactors, which correspond to boiler furnaces. This entails the construction of large pressure vessels as well as the design and development of fuel elements and handling equipment.

We were informed that work is now in hand on the reactor vessel ordered last June for Canada, the first nuclear power plant in the Commonwealth overseas. Designed for 1,200/lb sq in, it will be 12ft in diameter, 35ft high and 5in to 6½in thick. Its weight is 210 tons, of which 70 tons is in the demountable bolted-on head, which contains numerous small openings, each with its own enclosure. Extreme pressure-tightness is called for because the vessel contains costly heavy water.

New Atomic Department

To deal with these aspects creatively and to co-ordinate the nuclear work of other departments, an atomic energy department (the culmination of nearly ten years' work on the subject) has been set up with Mr. T. B. Webb as manager under the direction of Mr. W. F. C. Schaap (director and chief engineer of the company). Designing will be facilitated by the installation next year of a Ferranti " Pegasus " electronic computer.

Fusion welding, developed from a technique pioneered by Babcock & Wilcox 30 years ago, in conjunction with automatic welding machines is much in evidence in building up the parts of pressure vessels. Complete examination of welds is made with X-ray plant with a capacity of 2,000 kV. The close collaboration maintained with steel makers in the improvement of steels is said to make it certain that larger vessels can be constructed for higher pressures without unduly increasing plate thickness. Half-scale versions of unusual forms will be tested to destruction in the research department, following which a part-version of a full-scale model will be similarly treated.

Steam Raising Towers

Many sections, 17ft 6in in diameter, of steam-raising towers for Chapel Cross were seen in various stages of production and testing up to the final stress-relieving and bracing for transport. These processes include supersonic methods of plate testing, the welding to the shell of thermal sleeves (to which heat-exchanger connections are to be welded on the site) and electronic detection of any leakage at these welds by filling the sleeves with halogen gas under pressure and applying an ionising gun to the weld exterior.

Domed ends for steam-raising towers were being fabricated from segment plates formed in a new 2,000 ton hydraulic press, the power operating cylinders of which are located in a 40ft deep pit. A sliding table carrying the lower die facilitates the positioning of the plate after preheating. Control is by a single operator from a central panel. This press can deal with plates up to 7in thick, typically 12ft in diameter and over 40ft in length as required for a reactor pressure vessel for an overseas nuclear plant.

Additional facilities for manipulating the large number of tubes of complex shapes required for modern boilers and heat-exchanger surfaces, and fabricated manifolds are provided by two new bays, 700ft long by 100ft wide. The relatively low pressure at which the tubes at Calder Hall and Chapel Cross operate enables electric resistance welding to be employed. The number of aerofoil studs to be welded on amounts to nearly 11 million for each of the 32 towers for the Calder Hall and Chapel Cross stations.

More than 270 persons are engaged in the research and development department at Renfrew, but extensions are in hand, more specifically in connection with nuclear power. An important activity of the chemical section is the testing of the compatibility of fuel-can materials with uranium at 400 to 450 deg C in a CO_2 atmosphere and enclosed in graphite. Further requisites are adequate strength and ductility at high temperature, good heat transfer and low absorption of neutrons. Materials under present investigation include magnesium alloy, such as Magnox, and zirconium alloys, which will be subjected to a prolonged series of tests to examine corrosion effects under simulated operating conditions. These investigations are to be extended to liquid metal reactors.

Apparatus used in long period scaling tests now carried out for high-pressure boilers fired with a wide variety of fuels (results being extrapolated to 100,000 hours of service) is being adopted to investigate the performance in operation of materials for nuclear plant. Additional spectrographic equipment is to be installed for the determination of any

Nuclear Developments

important though minute trace elements in new or unusual materials.

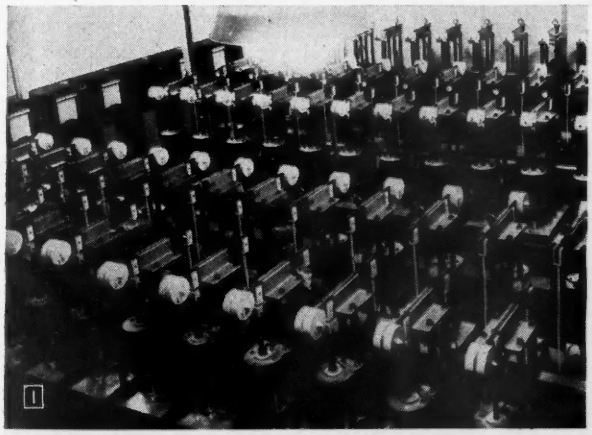
The effect of temperature cycling on canned fuel elements of different expansion characteristics is examined in a test rig in which a uranium rod in a Magnox can is subject to changes of temperature corresponding to those of insertion into and withdrawal from a reactor. The sample element, enclosed in a steel tube containing argon gas, is lowered into an electrically heated chamber maintained at 400 deg C and periodically removed and cooled to room temperature. Unequal expansions of the rod and can (" ratcheting ") are observed by X-ray photography.

In addition to conventional mechanical tests of metals, creep-strain testing of alloys of aluminium, beryllium and zirconium will be carried out. The number of machines for hot-stress-rupturing, as requisite also for conventional boilers, is to be increased, as a large proportion of the 84 now installed are being used for Magnox alloy cans. A Werner & Pfleiderer 4,500 lb/sq in pulsating pressure plant, installed in 1952 for hydraulic fatigue testing of pressure-vessel performance to point of failure, is being supplemented by a new plant rated at 6,000 lb/sq in.

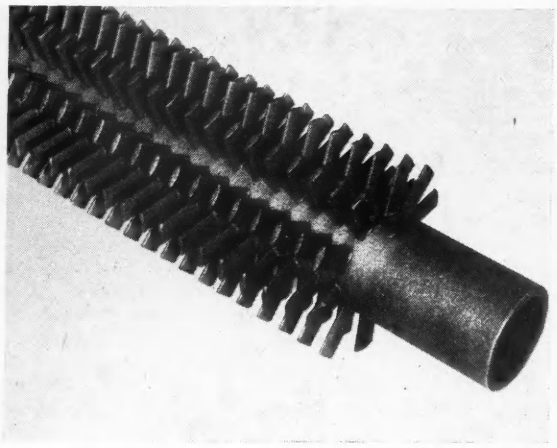
About 300 designs of fuel can having different extended surfaces have already been rough-tested for suitability as to air pressure drop along the surface and to heat transfer by being steam-heated in a lagged cylindrical vessel through which air is circulated, simulating gas flow in a reactor. The most promising are selected for closer ascertainment of performance by means of a test rig representing conditions in a gas-cooled reactor. In this apparatus a can containing an electrically heated element is placed inside a steel pipe forming part of a closed circuit in which CO_2 is circulated under pressure. Measurements of flow, pressures, temperatures and electrical input to the fuel rod enable heat transfer and gas-flow resistance characteristics to be accurately assessed. The high heat rating of a reactor fuel element prevents the introduction into the confined space of ordinary methods of electric heating, but this difficulty has been obviated by a novel technique.

Renfrew Works Expansion

At a dinner which followed the visit, Mr. C. H. Davy (director) briefly summarised the history of the British company of Babcock & Wilcox since its inception 60 years ago, during which the Renfrew site had been increased from 10 to 165 acres. The present extent had been



1. Part of battery of 84 hot-stress-rupture machines. 2. Electric strain gauges fitted to exterior of push out. 3. Assembly line for domed heads. 4. Welding thermal sleeves to shell for external connections



Detail of studded tube construction for heat-exchanger element as tested in boiler heat-transfer testing

demonstrated earlier in the day by Mr. D. D. Cruickshank (works manager) with the aid of a scale model on the roof of the general office, from which the whole area could be viewed. Mr. Davy emphasised that during the manufacture of the equipment for Calder Hall, work on conventional steam generating plant was still going on, reaching in 1954 and 1955 an aggregate of 128,000 tons of finished products shipped to all parts of the world. Almost all of the equipment was " tailor-made " and so had to be sold before starting detailed design and manufacture. Now inquiries concerning nuclear plant were coming in from various other countries.

Supporting particulars were then given by Mr. W. R. Wooton (deputy manager, atomic energy department), who mentioned the mixture of conventional and unconventional work involved in the construction of Calder Hall by a team which also included the English Electric Co. and Taylor Woodrow. Indications were that the conservative gas-cooled graphite-moderated reactor might have wider application than was thought at first, but there was always the possibility that its place might be taken by another radically different. Many Babcock & Wilcox engineers had attended the reactor school at Harwell and were well qualified to undertake the nuclear and thermodynamic calculating which preceded design. The anticipated growth of electric power demand would make the calls on manufacturers of heavy generating plant increasingly severe and conventional and nuclear fuels would be complementary for a long time to come.

Compressed Gas Insulation

TWO papers concerning the use of gases under pressure for insulating high-voltage apparatus and for research in physics were presented on 6th November before the I.E.E. Measurement and Control Section. The first, by Dr. E. H. Holt (Illinois University, formerly with A.E.I., Ltd.), described an experimental study of spark-breakdown potentials in air and nitrogen at from 1 to 70 atmospheres at 150 kV d.c. and electrodes giving a uniform field in a gap of 1 to 3 atmospheres. A small pressurised Van de Graaff electrostatic generator and a test pressure vessel were installed at Queen Mary College, London. The unfixed oxygen content and other impurities of the commercial nitrogen used influenced the electric strength significantly and prevented any assessment of practical value above 10 atm. Sulphur hexafluoride, carbon dioxide and certain fluormethanes were tested up to their saturation vapour pressures and with various mixtures of air. Paschen's law that sparking potential is a function of the product of gas pressure and gap length held good up to between 15 and 20 atm, but at higher pressures deviations gradually increased.

In the second paper Dr. P. R. Howard (National Physical Laboratory) pointed out that the electric strengths of air, nitrogen and carbon dioxide were comparable with those of liquids and solids only when subjected to considerable compression. On the other hand complex chlorinated and fluorinated molecular compounds in some cases possessed high electric strengths at relatively low gas pressures. He then described experiments carried out to assess the performance of halogenated methane compounds and sulphur hexafluorides as insulants for high-voltage equipments. The general conclusion reached was that sulphur-hexafluoride and difluorodichloromethane (especially the former) seemed worth considering for h.v. insulation.

Mr. R. Davis (N.P.L.) said that the gas discharge problem was very important because the processes that were involved might be applicable in many aspects of liquid and solid physics, and it was even possible that in the future it might play its part in discussions of fusion processes in the atomic energy field. It was also fascinating because so many sorts of processes were involved. Dr. Howard had suggested that the criterion for breakdown was that the field had to be such that the number of electrons which were available to create new electrons by hitting neutral ions was about equal to the number which were captured by the electro-negative gas. If that were so it seemed that one would never get the build-up of an avalanche, so it was difficult to understand why there should be a breakdown.

Mr. F. S. Edwards (Metropolitan-Vickers), referring to the statement in Dr. Howard's paper that, on the basis of providing the same power-frequency electric strength in a uniform field, the relative costs of oxygen-free nitrogen, transformer oil, difluorodichloromethane and sulphur hexafluoride in this country were in the ratio of 1 : 6 : 7 : 94, said that he presumed that this was the cost of the gas and took no account of the container. One important point to which no specific reference was made in the paper was the impulse ratio of the various filling media. The negative impulse figures given in the paper showed that the transformer oil on a $\frac{1}{2}$ cm spacing had a far higher breakdown voltage than any of the proposed substitutes. It was particularly unfortunate that SF_6 and Arcton 6 had quite a low impulse ratio, and it was rather unfortunate that the least satisfactory gases appeared to have the highest impulse ratio. If one used SF_6 or Arcton 6 where an impulse test had to be applied, it would be necessary to design much more lavishly, and presumably the ratios of the costs would be completely altered, and the SF_6 would cost about 400 times as much as air.

Dr. H. Tropper gave a brief reply on the paper by Dr. Holt, which he had presented on behalf of the author.

Dr. H. Howard, in reply to Mr. Edwards, said that the economics of the gases had been considered without any regard being paid to the tank that would have to be built, assuming that it might need to be stronger. He accepted that the impulse strength of these gases was lower than that of oil, and if the impulse strength for a particular equipment was to be a deciding factor, then the economics would be even worse than he had shown, particularly in the case of sulphur hexafluoride; but there were applications in which one was purely concerned with the ordinary power-frequency breakdown.

VIEWS on the NEWS

By REFLECTOR

MR. GEORGE SCHWARTZ in the *Sunday Times* reinforces very effectively the arguments pressed by the electrical industry for the relief of domestic appliances from purchase tax. He bases his remarks on an address by the Minister of Labour (Mr. McLeod) on the need for married women in industry. Mr. Schwartz quotes the Minister as saying that as we could not expect any increase in the supply of domestic help we could only hope that the use of modern labour-saving devices in the home, " together with the present-day simpler style of living in professional households " would make it possible for more married women to resume their pre-marital careers. Mr. Schwartz says there is no record that any woman in the audience got up and said :—

> " Well, Mr. Clever, if that's what you hope, why do you put savage purchase taxes and stringent hire purchase restrictions on household equipment? Why don't you subsidise it instead? "

I think it only fair to remark that Mr. McLeod is, after all, not the Chancellor of the Exchequer although, I suppose, he shares the responsibility for Treasury policy.

* * *

The inquiry into gas and electric cookers presented in the B.B.C. television series " Look and Choose " last week dealt with the subject far too superficially, in my opinion, to be of much use to the housewife. Examples of each type of cooker, one basic and the others of more elaborate design, were shown. The actual makes, however, were not revealed, although they were no doubt recognisable by many viewers. Among the points brought out in the discussion, in which Mr. A. M. Parkinson, sales manager of the English Electric Co.'s Domestic Appliance and Television Division, represented B.E.A.M.A., was the reason why electric cookers do not have plate racks—there is no waste heat from the hob. It might also have been pointed out that the plates are kept cleaner by being stored out of the way of the cooking fumes. One of the chief advantages which the modern electric cooker has over its gas counterpart is the provision made for automatic cooking. Mr. E. W. B. Dunning, representing the Gas Council, said that they proposed to have automatic timers as well, which he admitted meant having "a certain amount of electricity" on gas cookers—not a very satisfactory arrangement I am sure.

* * *

Why is it that, while concessions are made to encourage the installation of efficient fuel-burning appliances, people are deterred from buying the cleanest and most efficient heating equipment there is—electric? The St. Pancras Borough Council recently wrote to the Financial Secretary to the Treasury expressing the opinion that in view of the need for cleaner atmosphere electric heating appliances should be exempt from any restrictions as to initial payment and period of hire purchase and that any new restrictions on Electricity Boards' capital expenditure covering the sale of heating appliances under hire purchase arrangements should be removed. The Council was informed by the Ministry of Fuel and Power that present economic conditions made it impossible to do this, but I am glad to say that the matter is being pressed further by the Metropolitan Boroughs' Standing Joint Committee which has expressed agreement with the St. Pancras Council's views.

* * *

I find it strange to read in the *Electrical Contractor and Retailer* that " most electrical contractors who run retail premises find themselves eventually forced into the field of radio." From the beginning of broadcasting I considered radio to be the electrical retailers' business, but gradually " specialist " concerns (many of them of a doubtful or fly-by-night nature) got into the business and most electrical retailers got out. I suppose that finance for what is so overwhelmingly a hire-purchase business, combined with an inordinate amount of " service," can be inferred as reasons. It may be, of course, that the spread of domestic electrification made electrical retailing a sufficient occupation in itself but this is rather doubtful. Anyhow, the note beginning with the remark quoted dealt with a firm of radio retailers which branched out into electrical retailing —not an uncommon occurrence nowadays. Still it seems strange to me.

* * *

I have seen a report in the *Welsh Gazette* of a recent meeting of the South Wales Electricity Consultative Council during which Alderman S. O. Davies (Carmarthen) is credited with saying that there was a tendency to make work too easy for the women in the country and he hoped that electricity would not make it too easy for the farm worker. The alderman did not explain his strange objection to easing the lot of the rural dweller, but I am sure that the retort of a lady member of the Council that " that type of talk cut no ice at all " will be echoed by rural housewives and farm workers throughout the country.

* * *

Eighty years ago (15th November, 1876) the *Electrical Review* published the following rather strange report of an experiment by Professor W. A. Anthony with an electromagnetic machine of the Gramme pattern :—

> " The electric machine was driven by a five-horse Brayton petroleum oil-engine. The engine consumed a little over six-and-a-half lbs of crude petroleum per hour. The lamp used in the engine, by which the explosive mixture is fired, had a one-inch flat wick, and consumed 29·8 grammes (459 grains) of oil per hour. The power resulting from the motion of the engine, when applied to the electric machine, produced a stream of electricity or electric light having an illuminating power equal to that of 234 of the lamps mentioned, showing that three times more light may be produced from a given quantity of oil, if its energy is converted first into mechanical power and then into electricity, than if the oil is directly burned in a lamp."

INDUSTRIAL NEWS

Rental Agreements

The Board of Trade has made an Order prohibiting the disposal and possession of goods to which the Hire-Purchase and Credit Sale Agreements (Control) Order, 1956, applies under hiring agreements which provide for rebates of rentals based on the value of the goods. The Order is the Control of Hiring (Rebates) Order, 1956 (S.I. 1956 No. 1716). It applies to all agreements made on or after 8th November. The existing controls over the hiring of vehicles, radio and television sets and certain other consumer goods, which principally require advance payments of nine months' rentals, remain in force.

Window Display Competition

Wigan, in the No. 2 Sub-Area of the North Western Electricity Board, has been adjudged the winner of the Board's eighth annual window display competition. Nearly 100 service centres entered the competition—the theme of which was "Automation." As in the past, displays had to be produced on a small budget and were first judged on a Sub-Area basis before final area judging by a panel comprising Board members, senior officers and outside display specialists. Other Sub-Area winners were Chorlton (No. 1 Sub-Area); Glossop (No. 3 Sub-Area); Blackpool (No. 4 Sub-Area); Burnley (No. 5 Sub-Area); Whitehaven (No. 6 Sub-Area); and New Mills (No. 7 Sub-Area).

Winning display in the North Western Board's window competition

Swiss Reactor

Isotope Developments, Ltd., are acting as consultants to Landis & Gyr A.G. for the instrumentation of the new high-power Swiss 20 MW materials testing heavy water moderated reactor which is being designed and built by Reaktor A.G. Isotope Developments, Ltd., is responsible for the recommendation and supply of the full nucleonic instrumentation, which includes the equipment for the channels for controlling and safeguarding the reactor and its surroundings.

Television in Australia

Last week the Prime Minister of Australia, Mr. R. G. Menzies, opened the Australian Broadcasting Corporation's first television station, in Sydney.

"Building for Warmth"

This is the title of a 16-page booklet published by the Domestic Insulation Committee, representing the Coal Utilisation Council, the British Electrical Development Association and the Gas Council. It gives advice on heat insulation to those about to build or buy houses and sets out particulars of insulating materials and methods of applying them (illustrated) both to the structure of the house and the hot water system. Some idea of the cost of insulation is given. The booklet is obtainable from electricity and gas service centres and coal information centres free of charge.

Science and Technology Awards

By arrangement with the Ministry of Education and the Treasury, the Department of Scientific and Industrial Research has assumed responsibility for making practically all fresh awards from public funds to post-graduate students in science and technology. The awards will be made for training in research as in the past, but in addition will also be made for courses of advanced instruction. There will be two types of award for which students having good honours degrees will be eligible. Research studentships will be available to post-graduate students seeking two or three years of supervised training in research, leading in most cases to a doctorate of philosophy. The qualifications for these awards, formally called maintenance allowances, and the regulations governing them, are already well known in the universities and colleges of Great Britain. Advanced course studentships will be awarded to selected post-graduate students wishing to attend courses of advanced instruction in science and technology.

Students who have recently graduated with honours, or hope shortly to do so, should apply to the heads of departments at the universities and colleges, to whom information about the studentship has already been sent. Applications will have to reach the D.S.I.R. from heads of departments where students hope to work by 1st March, 1957. Selection will be on the recommendation of a Post-Graduate Training Branch Committee drawn largely from the universities.

Women Engineering Workers' Pay

A claim has been presented to the employers in the engineering industry for equal pay for about 400,000 women workers in the industry. The basic weekly pay for adult women is about 29s below the men's rate.

Australian Tariff Preference

The United Kingdom and Australian Governments have reached a new trade agreement, to be concluded early next year, by which the Australian Government undertakes to continue the import tariff preferences upon United Kingdom goods but reserves the right to modify them. For certain listed goods a margin of preference of 7½ per cent is guaranteed; these goods include the following:—

Steam and water turbines and parts; internal combustion engines; boilers and steam turbines; outdoor circuit-breakers; other circuit-breakers—switch units; lightning arrestors for power stations; voltage regulators; relays for power stations and other purposes; electrical control equipment; switches, fuses, cut-outs, relays; electrical regulating, starting and controlling apparatus; dynamo-electric machines; static transformers; covered cable and wire; electrical measuring and recording instruments; electrical porcelain ware; and electrical cloth-cutting machines.

The Australian Government agrees not to raise protective duties above a level that will give United Kingdom producers full opportunity of reasonable competition except in special circumstances. Both Governments intend to introduce anti-dumping legislation to prevent injurious action by third-party countries. Protection

The new factory of Brentford Transformers, Ltd., at Crawley, Sussex

by tariffs will be afforded only to Australian industries which are reasonably sure of success.

Automation Conference

A one-day Conference on "Automation, Education and Training," organised by the British Association for Commercial and Industrial Education (BACIE), will be held at the Royal Festival Hall, London, S.E.1, on 4th December. The Conference fee is £2 2s, and applications should be made to the Conference Secretary, BACIE, 8, Hill Street, London, W.1.

New Transformer Factory

Twenty years ago the firm of Brentford Transformers was first formed and in 1947, when the total number of employees was 65, new premises were taken over in Kidbrooke. Since that time the company has expanded rapidly and now employs a total of 265 people in a new 50,000 sq ft factory which has been erected on a 4½ acre site rented from the Crawley Development Corporation in Sussex. The factory was designed by C. W. Glover & Partners and built by Taylor Woodrow Construction, Ltd. Although it is of adequate size for present requirements there is room on the site for expansion to a further 80,000 sq ft of manufacturing space.

The main products of the company are voltage regulators and h.v. transformers, but a speciality is also made of Class "H" (dry type) transformers and low loss pole mounting units known as "Polemasters." In view of the specialised nature of the products 90 per cent of the workmen in the factory are skilled and apart from the drawing office staff there are 25 senior engineers.

Salford Electrical Instruments' Training Scheme

A comprehensive apprentice training scheme, catering for a total of 150 trainees of all grades, has recently been introduced by Salford Electrical Instruments, Ltd., a subsidiary company of the G.E.C. Although the scheme has been in operation only since the middle of August, the company already has a well-furnished apprentices' hostel in use; this was formally opened on 5th November. In addition, the facilities for training include a new machine shop which has been opened at the company's Birch Mill works near Heywood, to take groups of sixteen students at a time, and a drawing school adjacent to the hostel for training in draughtsmanship. These training facilities, although adequate at present, are of a temporary nature to tide the scheme over the next twelve months. The company then intends to set up a new training school which will incorporate a new drawing office, tool training shop and a fully-equipped machine shop.

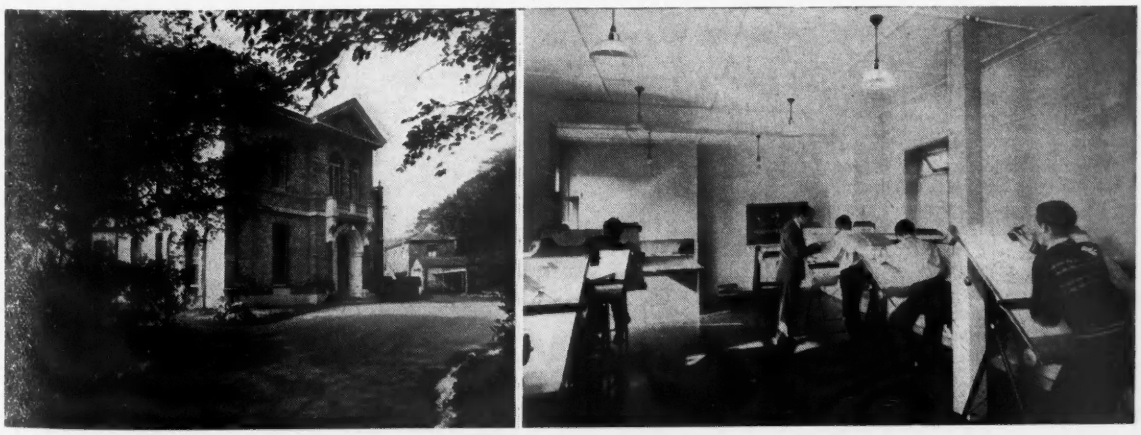
The basic training syllabus takes apprentices through the use of tools and machines, the fundamental processes of engineering, lectures on the G.E.C. and S.E.I., and specialist lectures. Visits are made to each factory of the company, and to associated industries such as steel works.

The new apprentices' hostel—the third within the G.E.C. organisation—is a spacious mansion called "Oaklands," at Kersal, near Salford, overlooking Old Manchester Golf Course. In furnishing it as a hostel, a comfortable domestic atmosphere has been retained while providing accommodation in bedrooms for two, three or four apprentices, a dining-room, lounge, study and games room. Development of the large grounds is planned to provide outdoor recreation including tennis, cricket and football. Full board residence is available to graduate trainees and student apprentices at a reasonable weekly charge.

New Acoustic Company

A new company known as Sound Control, Ltd., has been formed by the Thermotank Group to provide architects, designers, plant engineers, and

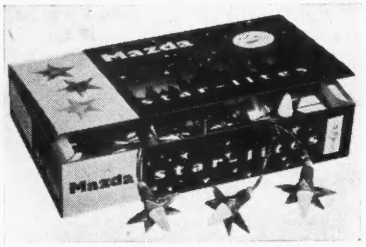
"Oaklands," the new apprentices' hostel of Salford Electrical Instruments, Ltd., at Kersal, near Salford, showing (right) the drawing school adjacent to the hostel



industry generally, with a complete service covering all aspects of architectural acoustics. The new company will operate from Colneside Works, West Drayton, Middlesex. The managing director is Mr. D. G. Smart. In addition to its general acoustical engineering and consultancy work the company will be concerned with the noise control of the air conditioning, heating and ventilating systems designed and manufactured by Thermotank, Ltd.

Decoration Lighting Sets

The A.E.I. Lamp & Lighting Co., Ltd., has introduced three new "Mazda" decoration sets for Christmas. "Mazda Star-lites" and "Noel-lites" are boxed in sets of twelve lights wired in series and "Mazda" indoor lighting sets in sets of eight lights wired in parallel. The "Star-lites" are brightly coloured plastic stars with coloured 3 W 18 mm bulbs as centres wired in series for 200-260 V supplies. "Noel-lites" are sets of small coloured



The "Mazda Star-lites" decoration lighting sets

plastic figures of Father Christmas, snowmen, angels and animals, internally illuminated. They are wired in series for 200-260 V supplies. Fixing is by small spring-loaded crocodile clips.

Both sets are packed, with a spare bulb, in attractive full colour lithoed boxes. The indoor lighting sets consist of eight coloured 15 W 50 mm round lamps with holders and wiring, for use on 230-250 V supplies. They are designed for use in hotel bars, foyers and for similar applications. As many as eight sets may be connected across a common line with safety. The "Mazda Disneylights," "Fairylights" and "Elfin Lites" are also available.

Iron and Steel Tube Imports

The Board of Trade announces that the Open General Licence has been further amended with effect from 12th November. Copies of this Amendment No. 9 will be obtainable from H.M. Stationery Office, Kingsway, London, W.C.2. The principal effect of these amendments is that iron and steel pipes and tubes may now be imported without an individual import licence if originating in and consigned from Western European and certain other countries. This brings iron and steel pipes and tubes into line with other similar iron and steel goods, virtually all of which are admitted without quantitative limitation from Western Europe and certain other countries as well as the Sterling Area. As certain duty changes affecting iron and steel pipes and tubes came into force on 9th November, this occasion has been taken for altering the import licensing arrangements for these goods.

Heavy Plant Manufacture in India

The Associated Cement Companies, Ltd. (Bombay), Vickers, Ltd. (London) and Babcock & Wilcox, Ltd. (London) announce the formation of a company to be known as ACC-Vickers-Babcock (Private), Ltd. (A.V.B.). This company plans (with the Indian Government's approval) to build a heavy engineering works in the vicinity of Durgapur, West Bengal. The products to be manufactured will include cement making machinery, mining machinery, large pumps, heavy gears, steam generating plant of all types, pressure vessels, cranes and mechanical handling equipment.

Birmingham Rapid Transit Proposal

The Birmingham correspondent of *The Times* says that the traffic conference set up by the Birmingham City Council two years ago is to be reconvened to consider a report proposing a rapid transit system of fast electric rail coaches running on central reserved roadway tracks and going underground in the centre of the city. Apparently it is thought that the existing high-speed tracks, which have been disused since the trams were abandoned in 1952, could again be brought into use.

Dimplex Southampton Factories

On 7th November electrical wholesalers and members of the Press visited the two new factories of Dimplex, Ltd., for oil-filled heaters and convector heaters, at Millbrook, Southampton. Mr. E. J. Wade, managing director, briefly described the activities of the company, and gave particulars of further developments.

The new factories have a floor space of 50,000 sq ft; one is devoted to the toolroom, press shop and the spot and gas welding departments, and the other deals with the treatment of tanks, spray and stove enamelling plant, assembly, and packing and dispatch departments.

The toolroom is fully equipped and is capable of handling all requirements. The spot welding department has multi-spot welders which replace individual jig and single spot methods. "Edge welding" of the electric radiators is undertaken in the factory gas welding section. The spray shop operates on a conveyor system and incorporates the latest method of stove enamelling. After assembly the appliances, which have been oil-filled to a predetermined level, go to a test bay for a three-hour test run before final flash tests. Another line is engaged in the assembly of the company's new convector heaters.

Rewiring Brighton Houses

Brighton Corporation Housing Committee has approved a scheme for rewiring the electrical installations in approximately 1,800 houses on the Whitehawk, Moulsecoomb and Queen's Park estates at an estimated cost of £36,000 and for the installation of one power point on the first floors of houses which have no form of bedroom heating at a further cost of approximately £9,000, the scheme to be spread over nine years.

E.M.I. Welsh Factory Reorganisation

About 600 people employed at the Treorchy (Glam.) factory of Electric & Musical Industries are to be dismissed gradually during a period extending over the next year or so because of a reorganisation of some aspects of the company's activities to meet changing economic and market conditions, with a consequent regrouping of some of the production hitherto carried out at Treorchy. There will be no change in the battery manufacturing section of the factory, where about 150 people are employed, and where it is hoped to expand production.

South African Tariff Applications

The *Board of Trade Journal* reports that the South African Board of Trade and Industries has received an application for an increase in the duty on imported lampholders, switches, plugs and other electrical accessories for use on voltages less than 500 V by 30 per cent *ad valorem*. Another application asks for higher duties to be imposed on 1·5-6 kW single-phase 50 c/s 110-250 V alternators; 3-7·5 kW three-phase 50 c/s 125-500 V alterna-

The new Dimplex factories at Millbrook, Southampton

Rear of the new Simplex main London depot at Alperton, showing part of the transport fleet and the loading and dispatch bays and (right) Sir John Buchanan addressing the guests at the opening ceremony. On his right is Mr. E. G. Plucknett, joint managing director, Simplex Electric Co., Ltd.

tors; and electric welding generators, d.c. and a.c., up to 250 A.

Interested United Kingdom trade associations are being informed of these applications and members should get into touch with their associations. Firms wishing to make independent representations or desiring further information should address their inquiries to the Commercial Relations and Exports Department, Board of Trade, Horse Guards Avenue, London, S.W.1. (Ref. C.R.E. 12076/56.)

Engineering Electronics

Three Cantor lectures on "Engineering Electronics" are to be given by Mr. L. E. C. Hughes, A.C.G.I., D.I.C., B.Sc.(Eng.), Ph.D., M.I.E.E., at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, on Mondays, 26th November, 3rd December and 10th December commencing at 6 p.m. Applications for tickets should be addressed to the secretary of the Society.

Simplex Alperton Depot

Last week the new main London depot of Simplex Electric Co., Ltd., at Wharf Estate, Alperton, Middlesex, was officially opened by Sir John Buchanan, chairman of the London and S.E. Regional Board for Industry, in the presence of some 200 electrical contractors and wholesalers. Addressing the guests, Sir John congratulated the company on their bold decision to remove their dispatch and warehouse facilities from the centre of London and said that it was an example which, if followed by other manufacturers, would be of value in improving traffic conditions in the Metropolis.

In transferring its main London depot to Alperton the chief concern of the company was to improve its service to its customers and it was thought that the new facilities would greatly enhance this service. Their old premises in Tottenham Court Road had in any case been outgrown by their expanded business.

From the company's point of view the new site is ideal as it is easily accessible and also provides a clear run from the warehouse to their two manufacturing centres at Oldbury, Birmingham, and Blythe Bridge, Staffs. The depot has its own transport fleet and is the centre for a series of sub-depots at Luton, Reading and Ashford, Kent, which are dependent for all supplies on Alperton. At each sub-depot will be a local transport fleet and with this network fast delivery can be made to customers throughout the Southern and Home Counties areas.

The Alperton depot will also serve as a bulk breaking and distribution point for all Simplex and "Creda" products, namely, conduit, conduit fittings, switch and distribution gear, flameproof switchgear and fittings, lighting fittings, accessories, cookers, water heaters, spin dryers, space heaters and cable manufactured by the associate Mersey Cable Works, Ltd. The stores are laid out to give the greatest ease of access to all products, with those in greatest demand placed nearest to the loading bay. The storage bins are designed to accommodate multiples of every product, whether cartoned or loose, and the conduit store is sited to give access either by road or canal and is fitted with a gantry to speed handling. A modern stock filing and record system provides full details of every product in the stores.

Of special interest are the facilities which exist for building the simpler forms of switchboards to specific requirements, while the lighting department has its own drawing office for the preparation of lighting schemes. Test kitchens have also been installed for intensive testing under operating conditions of all "Creda" domestic electrical appliances. These facilities will, in addition, be used for testing recipes and compiling operating instructions.

The building occupies an area of

30,000 sq ft, 26,000 of which are devoted to warehouse space. In this it is estimated that half a million feet of conduit is stored, together with 500 cookers, 2,500 water heaters, 1,000 space heaters, 60 tons of conduit fittings, 100 tons of switchgear, 250 miles of cable, etc.

The general contractors were W. H. Gaze & Sons, Ltd.; the architects, Clive Pascall; and the electrical installation contractors, Rashleigh Phipps & Co., Ltd. The total connected load of the building is in the region of 130 kVA.

New Aerialite Premises

The head office and cable division of Aerialite, Ltd., at Stalybridge have been rehoused in a new administrative block with a floor space of 6,000 sq ft.

TRADE ANNOUNCEMENTS

A new branch office has been opened by **Square D, Ltd.**, at 72a, Queen's College Chambers, Paradise Street, Birmingham (telephone: Midland 4212). Mr. A. S. Paice, area manager for the Midlands, is in charge of the new office.

Matthews & Yates, Ltd., have transferred their Birmingham office to County Chambers, Corporation Street, Birmingham, 2 (telephone: Central 1089).

Heyes & Co., Ltd., Wigan, have opened a Scottish sales depot at 158, Bath Street, Glasgow, C.2. The company's representatives operating from this address are Messrs. J. Fisher and C. Smith.

Connollys (Blackley), Ltd., have opened a new and larger Midland sales office at 39-44, Watery Lane, Bordesley, Birmingham, 9 (telephone: Victoria 4991-2).

Kolster-Brandes, Ltd., has opened a new depot at 41, Bent Street, Cheetham (telephone: Blackfriars 3939). The depot manager is Mr. J. Evans.

Somelec Sales, Ltd., is removing its warehouse on 19th November to larger premises at 47, St. Paul's Street, Leeds, 1 (telephone: 34941).

The **Kenbar Electrical Co., Ltd.**, has moved to more commodious premises at Forsyth Road, Sheerwater, Woking, Surrey (telephone: Woking 5060).

DOMESTIC ELECTRICAL EQUIPMENT

THERMAL STORAGE WATER HEATERS

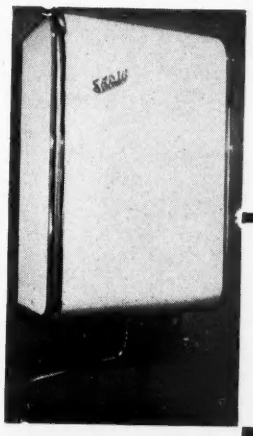
THE large number of electric thermal storage water heaters in use to-day is an indication of their usefulness and from the dozen or so manufacturers listed in the following survey types are obtainable to meet all needs, ranging from models designed to supply from 1½ gal up to 30 gal of hot water at one time. The greatest demand is probably for the smaller non-pressure type of water heater suitable for use at the kitchen sink or bathroom wash-basin. These normally have a capacity between 1½ gal (750 W) and 3 gal (1 kW) although for extra quick recovery after drawing off hot water the 3 gal models can also be obtained with a loading of 2 kW. The design of these self-contained models, manufactured in accordance with B.S. 843, has in recent years broken away from the earlier circular construction, and many are now rectangular in shape.

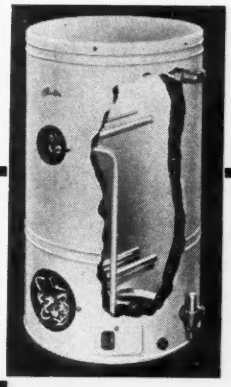
Lagging plays an important part in an appliance of this nature, and while granulated cork is still widely used for this purpose, several of the later models use fibreglass or, as is the case with the more recent Berry's A.Q./3 three gallon water heater, resin-bonded mineral cotton lagging. Colour is another important factor when it concerns the housewife and kitchen equipment and, in addition to white or cream, models are obtainable finished in blue or green.

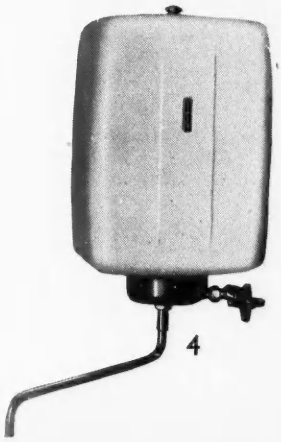
Installation is a simple matter. With the larger capacity cistern types it is only necessary to provide a connection to the cold water mains and pipes can be run to give a supply of hot water to several points in the house. As for prices, these remain much the same as those prevailing twelve months ago, but the purchase tax has been raised to 60 per cent.

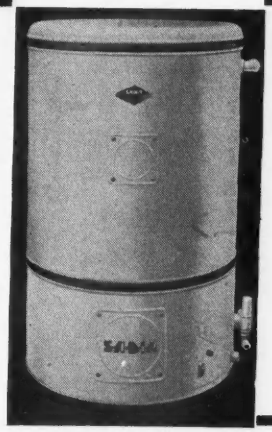
Manufacturer	Name or Model	Type	Capacity	Loading	Finish	Price (excl. tax)	Purchase Tax
AIDAS ELECTRIC, LTD., Rowdell Road, Northolt, Greenford, Middlesex.	G	Wall mounting, free outlet	1½ gal	500 W or 750 W	White with blue bands	£10 10 0	£4 18 4
	H	Wall mounting, free outlet	3 gal	½ kW to 1 kW	White with blue bands	£12 0 0	£5 12 4
	Select	Rectangular wall mounting, free outlet	3 gal	1 kW	Various colours, chromium mouldings	£15 0 0	£7 0 5
	U.T.C.	Wall mounting, pressure	3 gal	1½ kW	White with blue bands	£12 12 0	£5 18 0
	U.T.C.	Floor mounting, pressure	3 gal	1½ kW	White with blue bands	£13 2 0	£6 2 8
	B	Wall mounting, free outlet (A) or pressure (B)	5 gal	½ kW to 1 kW	White with blue bands	£17 0 0 (A) £16 0 0 (B)	£7 19 2 (A) £7 9 10 (B)
	L	Wall mounting, free outlet (A) or pressure (B)	7½ gal	¾ kW or 1 kW	White with blue bands	£19 0 0 (A) £18 0 0 (B)	£8 17 11 (A) £8 8 6 (B)
	C	Wall mounting, free outlet (A) or pressure (B)	12 gal	1 kW or 1½ kW	White with blue bands	£23 10 0 (A) £22 10 0 (B)	£11 0 0 (A) £10 10 8 (B)
	D	Wall mounting, free outlet (A) or pressure (B)	15 gal	1½ kW	White with blue bands	£26 10 0 (A) £25 10 0 (B)	£12 8 1 (A) £11 18 9 (B)
	U.D.B.–20	Floor mounting, pressure	20 gal	1 kW plus 2 kW	Mottled grey	£29 0 0	£13 11 6
	U.D.B.–20	Floor mounting, pressure (A) or wall mounting, pressure (B)	20 gal	1 kW plus 2 kW	White with blue bands	£30 0 0 (A) £30 15 0 (B)	£14 0 10 (A) £14 7 10 (B)
	U.D.B.–30	Floor mounting, pressure	30 gal	1 kW plus 2 kW	Mottled grey	£34 10 0	£16 3 0
	U.D.B.–30	Floor mounting, pressure (A) or wall mounting, pressure (B)	30 gal	1 kW plus 2 kW	White with blue bands	£35 10 0 (A) £36 5 0 (B)	£16 12 4 (A) £16 19 4 (B)
	I.S.	Floor mounting, pressure	40 gal	3 kW 6 kW 9 kW	White with blue bands	£55 0 0 (3 kW) £63 16 0 (6 kW) £72 12 0 (9 kW)	£25 14 10 (3 kW) £29 17 3 (6 kW) £33 19 7 (9 kW)
	B.B.T.	Wall mounting, cistern	5 gal	½ kW to 1 kW	White with blue bands	£23 0 0	£10 15 4
	L.B.T.	Wall mounting, cistern	7½ gal	¾ kW or 1 kW	White with blue bands	£27 10 0	£12 17 5
	C.B.T.	Wall mounting, cistern	12 gal	1 kW to 1½ kW	White with blue bands	£30 10 0	£14 5 6
	D.B.T.	Wall mounting, cistern	15 gal	1½ kW	White with blue bands	£33 10 0	£15 13 7
	U.D.B.–B.T.	Wall mounting or floor mounting, cistern	20 gal	2 kW or 3 kW	White with blue bands	£37 0 0	£17 6 4

Manufacturer	Name or Model	Type	Capacity	Loading	Finish	Price (excl. tax)	Purchase Tax
AIDAS ELECTRIC, LTD., Rowdell Road, Northolt, Greenford, Middlesex. *(continued)*	U.D.B.–B.T.	Wall mounting or floor mounting, cistern	30 gal	2 kW or 3 kW	White with blue bands	£42 10 0	£19 17 10
BERRY'S ELECTRIC, LTD., Touchbutton House, Newman Street, London, W.1.	"New Look"	Sink or basin	1½ gal	750 W	Green, blue, white or cream, chromium fittings	£12 17 6 (a.c.) £13 16 6 (d.c.)	£6 0 6 (a.c.) £6 9 5 (d.c.)
	A.Q./3	Sink or basin	3 gal	1 or 2 kW	Green, blue, white or cream, chromium fittings	£11 19 6 (1 kW) £12 9 6 (2 kW)	£5 12 1 (1 kW) £5 16 9 (2 kW)
BRITISH NATIONAL ELECTRICS, LTD., Newarthill, Motherwell, Lanarkshire.	B.N.E.	Non-pressure	1½ gal	750 W	White	£10 10 0	£4 18 4
	B.N.E.	Non-pressure	3 or 5 gal	1 kW	White	£12 10 0 (3 gal) £19 15 0 (5 gal)	£5 17 0 (3 gal) £9 4 10 (5 gal)
	B.N.E.	Non-pressure	12 gal	1½ kW	White	£29 15 0	£13 18 6
	B.N.E.	Pressure	5 gal	1 kW	White	£18 5 0	£8 10 10
	B.N.E.	Pressure	12 gal	1½ kW	White	£26 12 6	£12 9 3
	B.N.E. "Twin"	Dual-purpose	20 or 30 gal	500 W (upper) 2½ kW (lower)	White	£29 0 0 (20 gal) £34 10 0 (30 gal)	£13 11 5 (20 gal) £16 3 2 (30 gal)
ELTRON (LONDON), LTD., Accrington Works, Strathmore Road, Croydon, Surrey.	S.N.3	Small. Non-pressure under basin	¾ gal	1 kW	White enamel	£11 3 0	£5 0 4
	E.B.5	Overflow wall mounting	1½ gal	2 kW	White enamel	£14 10 0	£6 10 6
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	DE.700	Non-pressure (single-point)	1½ gal	1 kW	White stoved enamel	£12 12 0	£5 17 11
	DE.703	Non-pressure (single-point)	3 gal	1 kW	White stoved enamel	£14 11 6	£6 16 5

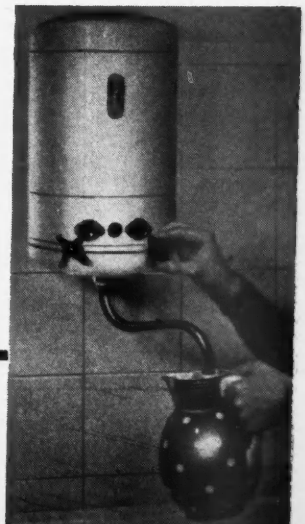






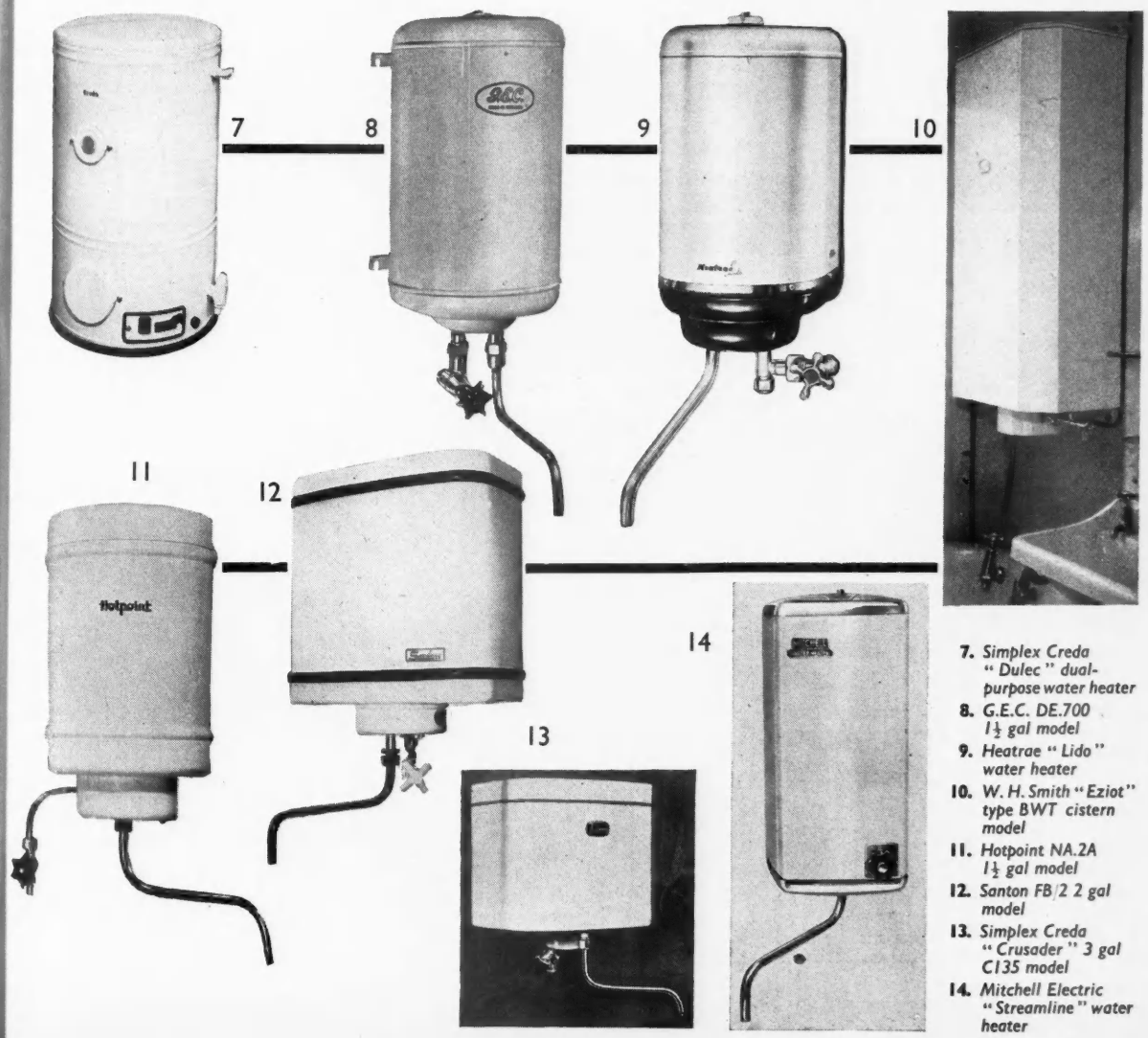


1. *Aidas Sadia "Select" 3 gal model*
2. *British National Electrics "Twin" dual-purpose model*
3. *Berry's "New Look" 1½ gal model*
4. *Berry's A.Q./3 3 gal water heater*
5. *Aidas Sadia U.D.B.–20 20 gal model*
6. *Eltron E.B.5 1½ gal water heater*



Manufacturer	Name or Model	Type	Capacity	Loading	Finish	Price (excl. tax)	Purchase Tax
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. *(continued)*	DE.705	Non-pressure (single-point)	5 gal	1 kW	White stoved enamel	£19 15 0	£9 4 10
	DE.710	Non-pressure (single-point)	12 gal	1½ kW	White stoved enamel	£29 15 0	£13 18 6
	DE.715	Pressure (multi-point)	15 gal	1½ kW	White stoved enamel	£30 10 0	£14 5 6
	DE.730	Pressure (multi-point)	30 gal	3 kW	White stoved enamel	£51 10 0	£24 2 0
	DE.731	Pressure (multi-point)	30 gal	3 kW (d.c.)	White stoved enamel	£53 10 0	£25 0 9
	DE.790	Pressure (multi-point)	20 gal	3 kW	White stoved enamel	£31 4 0	£14 12 2
	DE.726	Cistern	15 gal	1½ kW	White stoved enamel	£39 7 6	£18 8 7
	DE.727	Cistern	20 gal	2 kW	White stoved enamel	£42 10 0	£19 17 10
HEATRAE, LTD., Heatrae Works, Norwich.	"Lido"	Non-pressure	1½ gal (*a*) or 3 gal (*b*)	750 W and 1 kW (*a*) or 1 kW and 2 kW (*b*)	White, cream, blue or green stoved enamel	£10 17 6 (*a*) £12 9 0 (*b*)	£5 1 10 (*a*) £5 16 6 (*b*)
	U.B.	Non-pressure	2 gal	2 kW	White stoved enamel	£18 18 6	£8 17 2
THE HOTPOINT ELECTRIC APPLIANCE CO., LTD., Fletton, Peterborough.	NA.2A	Wall mounting, non-pressure	1½ gal	750 W	Cream stoved enamel	£10 10 0	£4 18 4
	"Dulec"	Floor mounting, pressure, dual-purpose	20 gal	Top: 500 W Bottom: 2½ kW	White stoved enamel	£29 0 0	£13 11 5
DUNCAN LOW, LTD., 299, Bell Street, Glasgow, C.4.	"Dulec"	Pressure, dual-purpose	20 or 30 gal	Top: 500 W Bottom: 2½ kW	White stoved enamel	£29 0 0 (20 gal) £34 10 0 (30 gal)	£13 11 6 (20 gal) £16 2 11 (30 gal)
MITCHELL ELECTRIC, LTD., 88-90, Tennant Street, Birmingham, 15.	"Streamline"	Non-pressure	1½ gal	750 W	White, cream, blue or green	£12 15 0	£6 2 5
	"Streamline"	Non-pressure	3 gal	1 kW	White, cream, blue or green	£14 4 6	£6 16 6
SANTON, LTD., Somerton Works, Newport, Mon.	FB/2	Non-pressure	2 gal	1·2 or 2 kW	White or cream stoved enamel	£11 17 6	£5 11 2
	NPT	Non-pressure	1½ to 20 gal	750 W to 2 kW	White enamel	£12 12 0 to £43 5 0	£5 17 11 to £20 4 10
	PT	Pressure, wall mounting	5 to 20 gal	1 to 2 kW	White enamel	£18 5 0 to £39 12 6	£8 10 10 to £18 10 11
	PT/FM	Pressure, floor mounting	20 gal (*a*) and 30 gal (*b*)	2 kW (*a*) and 3 kW (*b*)	White enamel	£56 5 0 (*a*) £68 0 0 (*b*)	£26 6 6 (*a*) £31 16 6 (*b*)
	DF	Cistern, wall mounting	5 to 20 gal	1 to 2 kW	White enamel	£26 5 0 to £48 0 0	£12 5 8 to £22 9 3
	DF/FM	Cistern, floor mounting	20 gal (*a*) and 30 gal (*b*)	2 kW (*a*) and 3 kW (*b*)	White enamel	£67 10 0 (*a*) £80 0 0 (*b*)	£31 11 10 (*a*) £37 8 10 (*b*)
	DF/R	Rectangular, cistern, wall mounting	5 gal (*a*) and 12 gal (*b*)	1 kW	White enamel	£35 10 0 (*a*) On application (*b*)	£16 12 3 (*a*) (*b*)
	NPT/E	Non-pressure, wall mounting	12 gal (*a*) and 15 gal (*b*)	1½ kW	White enamel	£29 15 0 (*a*) £33 17 6 (*b*)	£13 18 6 (*a*) £15 17 1 (*b*)
	PT/E	Pressure, wall mounting	12 to 20 gal	1½ and 2 kW	White enamel	£26 12 6 to £32 0 0	£12 9 3 to £14 19 6
	PT/EFM	Pressure, floor mounting	20 gal (*a*) and 30 gal (*b*)	3 kW	White enamel	£42 0 0 (*a*) £51 10 0 (*b*)	£19 13 2 (*a*) £24 2 1 (*b*)
	DF/E	Cistern, wall mounting	12 to 20 gal	1½ and 2 kW	White enamel	£35 15 0 to £42 10 0	£16 14 8 to £19 17 10
	DF/EFM	Cistern, floor mounting	20 gal (*a*) and 30 gal (*b*)	3 kW	White enamel	£52 0 0 (*a*) £60 0 0 (*b*)	£24 6 9 (*a*) £28 1 (*b*)
	"Monmouth"	Automatic dual, pressure	12 gal (*a*) and 20 gal (*b*)	Top: 3 kW Bottom: 3 kW	Cream enamel	£32 0 0 (*a*) £35 0 0 (*b*)	£14 19 6 (*a*) £16 7 7 (*b*)

Manufacturer	Name or Model	Type	Capacity	Loading	Finish	Price (excl. tax)	Purchase Tax
SANTON, LTD., Somerton Works, Newport, Mon. *(continued)*	PT/FM	Pressure, floor mounting	2½ gal	1 kW	White enamel	£17 5 0	£8 1 6
	NPT/FM	Non-pressure, floor mounting	2½ gal	1 kW	White enamel	£20 15 0	£9 14 3
SIMPLEX ELECTRIC, LTD., Blythe Bridge, Stoke-on-Trent, Staffs.	"Crusader" C141	Non-pressure	3 gal	1 kW	White or cream	£11 2 6	£5 4 2
	"Crusader" C135	Non-pressure	3 gal	2 kW	White or cream	£11 2 6	£5 4 2
	C7505	Non-pressure	5 gal	1 kW	White	£19 10 0	£9 2 6
	C7505P	Pressure	5 gal	1 kW	White	£18 0 0	£8 8 6
	C7505BR	Cistern	5 gal	1 kW	White	£25 0 0	£11 14 0
	C7512P	Pressure	12 gal	2 kW	White	£25 10 0	£11 18 8
	C7512	Non-pressure	12 gal	2 kW	White	£27 5 0	£12 15 1
	C7512BR	Cistern	12 gal	2 kW	White	£36 10 0	£17 1 8
	"Dulec"	Dual purpose	18·7 gal	3 kW	White	£29 0 0	£13 11 5
W. H. SMITH (EZIOT), LTD., 32, Mansfield Street, Church Gate, Leicester.	"Eziot" WT	Non-pressure	1½ gal	750 W	White or cream, etc.	£10 10 0	£4 18 4
	"Eziot" WT	Non-pressure	3 gal	1 kW	White or cream, etc.	£12 5 0	£5 14 8
	"Eziot" BWT	Built-in cistern	12 gal	1½ kW	White or cream, etc.	£36 6 6	£17 0 0



7. *Simplex Creda "Dulec" dual-purpose water heater*
8. *G.E.C. DE.700 1½ gal model*
9. *Heatrae "Lido" water heater*
10. *W. H. Smith "Eziot" type BWT cistern model*
11. *Hotpoint NA.2A 1½ gal model*
12. *Santon FB/2 2 gal model*
13. *Simplex Creda "Crusader" 3 gal C135 model*
14. *Mitchell Electric "Streamline" water heater*

GENERATION AND DEVELOPMENT

Sales of Domestic Appliances

The accompanying table shows the number of new appliances sold by Area Electricity Boards in England and Wales for the quarter and year ended 30th September, 1956, together with percentage changes. When assessing the figures, it must be remembered that the sales by Area Boards represent only a part of total sales throughout the country.

	Sales in quarter ended 30th Sept., 1956		Sales in twelve months ended 30th Sept., 1956	
	Total	Per cent change over June–Sept., 1955	Total	Per cent change
Cookers	51,241	− 2·4	206,760	−10·9
Water heaters—				
Immersion	40,568	−18·9	136,056	+ 3·9
Storage	10,359	+ 0·7	42,487	
Wash boilers	16,344	+19·4	58,366	+ 0·1
Washing machines ...	16,735	−52·1	86,723	−49·9
Refrigerators	10,190	−57·4	36,007	−32·0

South Scotland Rural Plan

A five-year plan for completing the electrification of the rural parts of its area has been approved by the South of Scotland Electricity Board. It provides for the connection of a further 2,500 farms and 7,200 other premises and the total estimated cost is £2,548,850. Construction work will be carried out in accordance with development programmes which are set out in a booklet published by the Board.

The plan covers only the Edinburgh and Borders, Fife and Stirling Areas, where rural development is least advanced. In the Glasgow, Lanarkshire, Clyde, Ayrshire, and Dumfries and Galloway Areas the occupiers of all but the most remotely situated farms and cottages have been offered a supply and all who have accepted have received it, or will do so by the end of next year. Of the 10,500 farms in these five Areas 8,660 (83 per cent) have already been connected to the mains. In the three Areas to be dealt with under the plan 3,500 (58 per cent) of the 6,000 farms have so far been supplied with electricity. A summary of the programme is given in the accompanying table.

The cost of the main distribution lines needed under the programme will be met by the Board but each consumer will be required to contribute towards the cost of spur and service lines. In the case of farms of 100 acres or more the payment will be £200 with a guarantee to take or pay for electricity to the value of £10 a quarter for five years. Both amounts will be suitably reduced for smaller farms. For cottages served from the farm transformer there will be a charge of £10 per cottage and 5s for each yard of service line in excess of 50 yards and £10 for each pole. If a separate transformer is required for the cottages, however, an additional charge of £100 will be made. The charges specified are for single-phase supplies; where three-phase is asked for the consumer must pay the extra cost.

Provision of supplies to farms and other premises situated within easy reach of existing distribution lines will continue to be dealt with as a matter of day-to-day routine provided that the work does not interfere with the programmes.

Area	Edinburgh and Borders	Fife	Stirling	Total
Number of schemes ...	42	12	41	95
Number of farms to be supplied, including those for which agreements have been completed ...	1,387	602	541	2,530
Number of miscellaneous premises to be supplied ...	5,666	1,317	222	7,205
Miles of h.v. lines	995	223	136	1,354
Miles of l.v. lines	342	59	77	478
Estimated cost	£1,821,100	£417,100	£310,650	£2,548,850

Distribution Extensions

Wallsend Town Council has approved plans by the North Eastern Electricity Board for the laying of underground cables to supply electricity to 54 three-storey flats at Willington West Farm and 150 houses and a school at Low Willington Farm estate. Plans have also been approved for laying a cable to the works of Commercial Plastics, Ltd., Willington Quay, and for reorganising the supply of electricity to the Rising Sun Colliery.

Rural Development in Ireland

Replying in the Dail to questions on rural electrification, Mr. Norton, Minister for Industry and Commerce, said that this year it was proposed to spend at least £3,400,000 on rural electrification. Information had been received from the Electricity Supply Board stating that the total number of rural dwellings was approximately 400,000, of which 181,000 had been connected with the E.S.B. network at 30th September last. At that time there were approximately 120,000 dwellings in the areas which had not yet been developed. Assuming that at least 80 areas would be completed in the current financial year, the number then remaining undeveloped would be approximately 250 out of a total of 800 areas. The rate of development for future years was still the subject of discussion with the Board.

Under-Floor Heating

South Shields Town Council is reported to be considering the use of under-floor electric heating in new houses. This system has been used at Kirkcaldy (Scotland) and the Council is to send a deputation there. The borough engineer (Mr. John Reid) informed the Council that the weekly cost of using electricity for under-floor heating, cooking, lighting, etc., would be about £1 for a two-bedroomed flat, and £1 2s for a three-bedroomed flat. Electricity used for heating would be supplied during off-peak periods at reduced tariffs, and rooms would be maintained at an average temperature of about 60 deg.

Tenants to Choose

Bridgwater Housing Committee has recommended that in future all houses erected by the Council shall be provided with both gas and electricity in order that tenants may choose which service they prefer, and that no more cookers and boilers shall be provided by the Council.

OVERSEAS

Trinidad Expansion

The latest report received from Mr. K. W. Finch, general manager of the Trinidad and Tobago Electricity Commission, shows that last year 4,782 people enjoyed the benefits of electricity for the first time, making the total number 29,757. Most of the new consumers were in the country districts. Consumption rose by 23·5 per cent to 107·7 million kWh. As a measure of the rate of expansion it may be noted that five years ago sales were less than half the present figure. Approximately two-thirds of last year's retail sales went to industry, a fifth to domestic and general lighting users and a twelfth to commercial customers. Industrial supplies were 46·7 per cent more than in 1954.

The year was notable for the numerous small extensions carried out, particularly in the northern area, and for the installation of the first submarine power cable in Trinidad, some 3,500ft of 12 kV cable being laid at a maximum depth of slightly over 100ft between the mainland and the island of Cronstadt. During installation the cable was damaged as a result of pilfering but is now operating satisfactorily.

At the end of the year the Commission owned three power stations

in Trinidad with a total installed capacity of 31,700 kW and a small diesel station in Tobago. Twelve licences for private generating plants were granted by the Government, two to sugar estates for plant burning bagasse as fuel and the remainder for small sets in remote areas.

This week-end the Governor of Trinidad and Tobago (Sir Edward Betham Beetham) is to commission a new 10,000 kW Metropolitan-Vickers steam turbo-generating unit at the Wrightson Road power station, Port-of-Spain, and a souvenir illustrated brochure has been issued to mark the occasion. In a foreword the chairman of the Trinidad and Tobago Electricity Commission (Mr. G. de Nobriga) says that the new set is expected to generate electricity more cheaply than previously installed equipment and to help to fight rising costs. The new set is designed to operate at 3,600 r.p.m. with initial steam conditions of 400 lb/sq in and 750 deg F.

Uganda Supply Extension

To-day (Friday) the Governor of Uganda, Sir Andrew Cohen, is to close a switch to initiate a supply to the township of Soroti in the Eastern Province of Uganda. This will be the most northerly point yet reached by the Uganda Electricity Board.

Soroti is the principal town of Teso, one of the six Districts of the Eastern Province, and is the centre of the cotton and hides trades in that part of Uganda. It will be supplied initially from a temporary local power station, with oil engine generation, but a 75 mile long 33 kV transmission line from Mbale, now under construction, will be commissioned next year, after which supply will be given from the 180 miles distant Owen Falls hydro-electric power station.

The 33 kV line from Mbale to Soroti, with a branch line to Serere, will supply a number of villages, cotton ginneries and missions, with their schools and hospitals, and also the extensive Government agricultural experimental station at Serere.

Inauguration of New Zealand Project

Roxburgh power station, the largest hydro-electric plant in New Zealand, was officially opened on 3rd November by the Minister of Works, Mr. W. S. Goosman. The four vertical water-wheel alternators so far installed were manufactured by the British Thomson-Houston Co., Ltd., at Rugby. Each is rated at 44,444 kVA, 0·9 p.f., 11 kV, 3-phase, 50 c/s, 136·4 r.p.m.

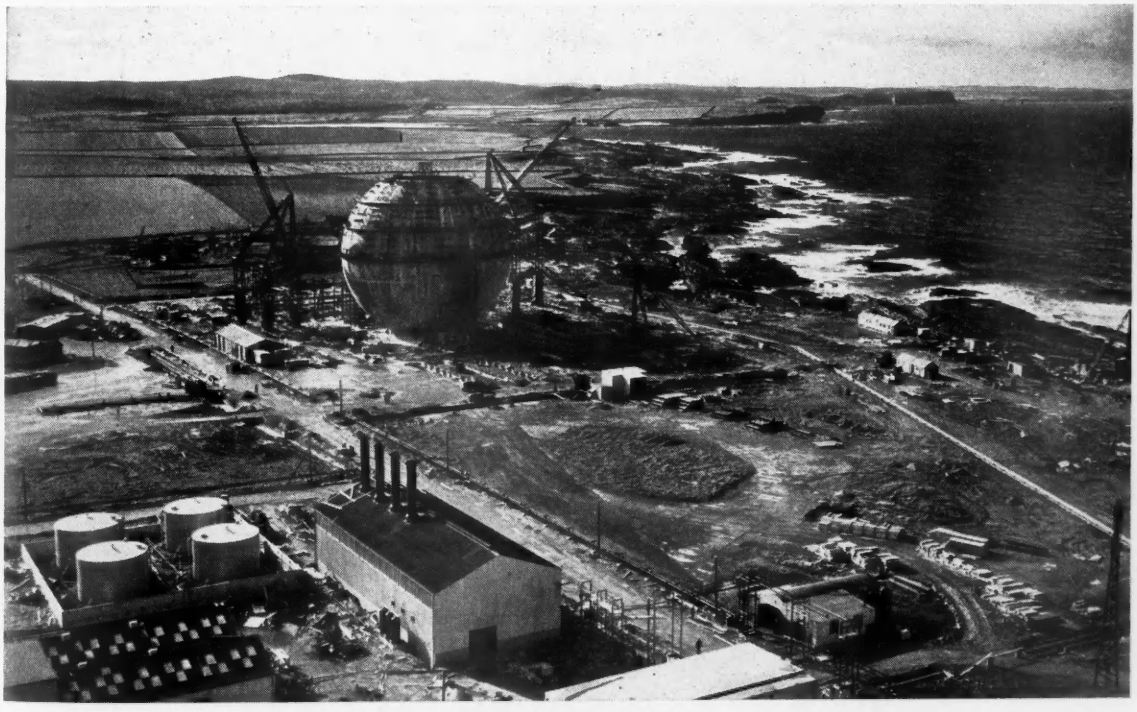
Transport limitations between the port of Dunedin and Roxburgh made it necessary to split each wound stator for shipment into six equal sections and each rotor was dispatched from the works almost entirely broken down into its smallest components. The stator winding is of the double layer lap type, the insulation being bitumen bonded mica with Haefely tube over the slot portion. To reduce eddy currents one turn in each coil is given a Roebel transposition outside the slot.

The only portions of the generators which are visible above the operating floor of the generator hall are the main and pilot exciters and the governor generators. The 9ft high stators are each accommodated in a 32ft square concrete pit, with twin air coolers bolted to the stator frame at each corner of the square. Fans mounted above and below the generator rotor circulate air inside the machine and through the coolers.

Transport in Ceylon

The Government of Ceylon is to make a loan of Rs.2 million to the Colombo Municipal Council for the extension of its trolley-bus system. The loan will be used chiefly to purchase vehicles for the third stage of the trolley-bus scheme. The new service will begin in November when 20 new single-decker trolley-buses, now on order, are due to arrive in Colombo.

The general manager of the Ceylon Railways, Mr. B. D. Rampala, is shortly to submit to the Ministry of Transport an estimate for the electrification of Colombo's suburban railways. Mr. Rampala says that investigations which are now being carried out by his Department have revealed that about Rs.75 million will be required including Rs.45 million for rolling stock. It is estimated that the cost of electrification will be about Rs.300,000 per mile excluding stock. Mr. Rampala is to visit the United Kingdom to make a detailed study of experiments being carried out here with high voltage supply.



A striking view taken from the top of the 180ft ventilating shaft of the 130ft diameter reactor sphere at Dounreay on the shore of the Pentland Firth in Caithness. Some 1,400 tons of steel has been used in the construction of the sphere which will be operational by 1958

Financial Section

STOCKS and SHARES

POLITICAL events have inevitably continued to dictate the course of Stock Exchange prices. Conditions are altered by the news from day to day, but it can be said that up to the beginning of this week, at least, a salient feature of market behaviour had been the refusal of the holder of good securities to be worried out of them. In the oil market, reactions to events had of course sometimes been violent. Elsewhere, neither the gilt-edged nor the industrial sections had come under heavy pressure, despite general appreciation of the stresses which Britain's trading and financial structure will have to stand, whatever the outcome of events may be. Business in electrical equipment and engineering shares has been as small in volume as in other sections of the industrial market, but prices have been standing their ground relatively well.

Tube Investments

The announcement by Tube Investments of substantially higher earnings in 1955–56, and of a dividend above earlier estimates, was accompanied by mention of some falling-off in the orders for certain sections of the group towards the end of the year in July and during the first quarter of the current period. After some rather sharp fluctuations, the price of the £1 shares was little altered on balance at about 56s 3d. A final dividend of 7½ per cent makes a total of 13¾ per cent, which is a point more than was indicated at the time of the big capital issue a year ago. This is equivalent, the company states, to 15 per cent, after taking into account the period during which the new shares were only partly paid up. It involves the distribution of £1,153,000 net, as compared with the previous figure of under a million, and absorbs less than a quarter of the available surplus, which has risen well above £5 million. On a 15 per cent basis the shares are showing a yield of 5·3 per cent.

Recent Issue

Success is announced for the Switchgear & Cowans issue of 200,000 5s ordinary shares, of which the great majority were taken up at 10s 6d on the allotment letters, the small balance being heavily over-subscribed. Now fully paid, the new shares have recently been quoted at 13s 3d. They will continue to be transferable free of stamp duty until the first fortnight of December. Watford Electric new 2s shares, of which 201,200 were offered to shareholders at 4s 9d, are also now fully paid up. They have been quoted at about 1s above the issue price. On the newly issued Automatic Telephone & Electric £1 ordinary shares, the second and final call of 26s is due by 7th December. In the case of the G.E.C. ordinary share issue the last instalment of 20s has to be paid by 4th January.

Plessey Results

The final dividend now declared by Plessey brings up the total for 1955–56

Price Changes in

Company or Board	Nom. Value	Middle price 12th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	73⅛	−1	3	3	4 1 9	80⅛	73⅛
Brit. Elec. 1974/77	100	72½	−1	3	3	4 2 9	79⅛	71½
Brit. Elec. 1976/79	100	76½		3½	3½	4 11 6	84	76½
Brit. Elec. 1974/79	100	86½		4⅛	4⅛	4 18 3	95	86½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	19/-
East African Power	£1	20/-		7	7	7 0 0	21/3	19/6
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	15/-		10	10*	13 6 9	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/6		17½	17½	7 12 3	13/6	10/6
Aerialite	1/-	5/6	−3d	45	48	8 18 0	6/9	4/9
Allen, W. H.	£1	38/-	−9d	20	10*	5 5 3	39/-	33/6
Aron Elec. Ord.	£1	55/-	−6d	15	15	5 9 0	56/-	53/6
Assd. Automation	10/-	16/6	−3d	10	5	3 0 6	19/-	16/6
Assoc. Elec. Ord.	£1	62/6	−1/3	14	15	4 16 0	85/6	57/9
Automatic Tel. & El.	£1	52/6	−1/3	15	15	5 14 3	72/6	52/6
Babcock & Wilcox	£1	73/9	+1/3	15	15	4 1 3	85/6	64/-
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/-	3/9
Bakelite	10/-	26/-		16	16	6 3 0	34/-	26/-
Berry's Electric	5/-	6/-		—	10‡	8 6 9	6/6	5/9
British Aluminium	£1	68/3	+9d	12	12	3 10 3	78/9	40/6
B.I. Callender's	£1	50/6	+3d	10	12½	4 19 0	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	22/6	20/3
British Tabulating	£1	43/9		9	9	4 2 6	51/3	37/3
British Thermostat	5/-	25/-		20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	7/9	−3d	30	15*	9 13 6	8/9	6/-
Brook Motors	10/-	35/-		20	25	7 2 9	44/-	31/9
Brush Group	5/-	4/9	−3d	10	10	10 10 6	7/9	4/9
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/3
Burco Dean	5/-	9/3	−3d	—	22½	12 3 0	13/6	8/3
Chloride El. Storage "A"	£1	61/3		17½	17½	5 14 3	73/6	60/9
Clarke Chapman	£1	115/-	−1/3	20	22½	3 18 3	123/-	89/6
Cole, E. K.	5/-	16/-		17½	17½	5 9 6	22/3	15/6
Cossor, A. C.	5/-	6/-		15	Nil	Nil	10/3	5/-
Crabtree	10/-	24/6		20	20	8 3 3	29/3	24/-
Crompton Parkinson Ord.	5/-	13/3		16	16	6 0 9	15/-	12/3
De La Rue	5/-	15/9	−3d	30	30	9 10 6	20/3	15/-
Decca "A"	4/-	25/9	−6d	56¼	43¾*	6 16 9	44/9	24/9
Desoutter	5/-	31/-		25	30	4 16 9	32/9	25/9
Dewhurst	2/-	6/-	+6d	24	30	—	7/6	5/3
Dictograph Tel.	2/-	7/-	−3d	20	20	5 14 3	7/3	5/6
Dubilier Condenser	1/-	5/3		25	30	5 14 3	5/3	3/6
Duport	5/-	18/6	−3d	23	25‡	6 15 3	21/6	13/9
E.M.I.	10/-	25/-	−1/-	15	15	6 0 0	37/-	25/-
Electrical Components	5/-	7/-	−6d	25	25	8 18 6*	8/-	6/3
Elec. Construction	£1	23/9		8½	8½	7 2 3	29/9	23/9
Elliott Bros.	5/-	24/-	−1/-	17½	20‡	4 3 3	36/9	24/-
Enfield Cable Ord.	£1	15/-		Nil	Nil	Nil	19/3	13/6
English Electric	£1	47/6		12½	12½	5 5 3	66/3	45/-
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	34/-	−6d	20†	20†	2 18 9†	42/9	33/6
Ever Ready	5/-	28/9	+6d	35	35	6 1 9	32/9	24/-
Falk Stadelmann	£1	38/-	−9d	17½	17½	9 4 3	45/9	36/9
G.E.C. Ord.	£1	43/9		12½	14	6 8 0	65/6	42/6
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/9		30	30	12 15 0	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	21/3	−1/-	25	30	7 1 3	24/6	18/9
Hackbridge & Hewittic	5/-	17/6		30	23*	6 11 6	22/-	17/3
Heatrae	2/-	3/9		15	15	8 0 0	5/1	3/9
Henley's	10/-	14/9	−6d	10½	11½	7 16 0	19/9	14/-
Holophane	5/-	19/9		30	30	7 12 0	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

to 30 per cent, the rate forecast at the time of the big issue of new capital at the beginning of this year. According to the preliminary statement, covering the twelve months to June, the group trading profit came out provisionally at a little over £1½ million, which is much the same as before, after bigger depreciation provisions. The tax charge is nearly £100,000 higher this time, and reduces the net surplus by roughly that amount to £703,000, but it still leaves a very wide margin above the amount of £235,000 net distributed in dividends. This is one factor which, in combination with the "growth" characteristics attributed to the business, accounts for the quotation of the shares, at 65s 6d, on the relatively low yield basis of not much over 4½ per cent.

Elliott and A.I.P.

Shareholders of Associated Insulated Products have accepted, to the extent of more than 86 per cent of the total share capital, the offer to exchange their shares for an equal number of Elliott Brothers (London) 5s ordinary shares. The offer, which remains open until the end of the year, has been declared unconditional. These announcements were followed by the declaration of 10 per cent interim dividends by both companies, the rate being designed simply to equalise the position between the two. Elliott Brothers are expecting to be in a position to recommend for the present year a final distribution also of 10 per cent, to which the existing and the newly issued shares would be entitled. One of the objects of the merger, it will be recalled, is to enable A.I.P.'s big cash resources to be invested in the fields of automation and electronics in which Elliott Brothers specialise. The latter's 5s shares are quoted at about 24s, giving a yield of 4·2 per cent on the 20 per cent rate of dividend indicated.

Aerialite Results

For a month or two the 1s shares of Aerialite have been exceptionally firm in the anticipation, which has now been realised, of good results for the year ended last May. According to the preliminary statement, the large expansion of earnings in 1954–55 has been followed up with a further improvement of 20 per cent in the net profit (despite heavier taxation) to £145,000. This accommodates easily an increase from 45 to 48 per cent in the ordinary dividend, which appears to be covered about 2½ times over by the available surplus. Subsequently the shares were quoted at 5s 6d, the yield being 8·9 per cent on the new rate of dividend.

Dewhurst Dividend

A final dividend, in respect of the year ended in September, is expected to be declared by Dewhurst & Partner a week from to-day (Friday). A year ago the company paid a final of 22½ per cent, making a total of 30 per cent for the twelve months. Last April a share-for-share scrip issue was made, and the rate of the interim dividend on the doubled capital of £360,000 was subsequently reduced, in proportion, to 3¾ per cent. The issue had the effect of capitalising part of the reserves built up over many years by a conservative financial policy. As a result of this, according to the last report, the company is able to meet out of its own resources the cost of the new building and equipment programme in hand.

Electrical Investments

Company or Board	Nom Value	Middle price 12th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	23/6		70	50	10 12 9	39/3	23/-
I.C.I.	£1	39/9	−6d	10	10	5 0 9	49/9	39/9
Intl. Combustion	5/-	18/9		25	20*	5 6 9	25/-	15/3
Johnson & Phillips	£1	37/-	−6d	15	15	8 2 3	46/6	37/-
Lancashire Dynamo	£1	40/-		15	11*	5 10 0	49/9	40/-
Laurence, Scott	5/-	15/3		12½	15	4 18 3	16/9	13/3
Lister, R. A.	£1	27/3		9·3	10	7 6 9	35/3	27/3
London Elec. Wire	£1	45/-		12½	12½	5 11 0	52/9	45/-
Lucas, J.	£1	29/6		7½	7½	5 1 9	40/3	29/6
Marryat & Scott	2/-	9/6		30	30	6 6 3	11/3	9/6
Mather & Platt	£1	53/6	−1/-	15	15	5 12 3	65/3	51/6
Metal Industries	£1	24/6	−1/-	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	26/3	+1/3	50	50	7 12 6	27/3	20/-
Murex	£1	67/6	−9d	20	20	5 18 6	74/6	60/-
Newman Ind.	2/-	2/6	+3d	10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/3	−3d	14	12	9 12 0	9/6	5/6
Parsons, C. A.	£1	90/-		10	10	2 4 6	96/-	61/6
Plessey	10/-	65/6	−2/-	27½	30	4 11 6	87/6	56/-
Pye "A" Deferred	5/-	15/9		12½	12½	3 19 3	21/3	14/-
Reyrolle	£1	100/-		15	16½	3 5 0	117/6	81/-
Rheostatic	4/-	9/9		18½	12†	4 19 0	—	8/3
Richardsons Westgarth	5/-	15/6		16⅝	16⅝	5 7 6	17/-	13/9
Scottish Cables	4/-	15/3		27½	27½	7 4 3	17/9	15/3
Smith (England), S.	4/-	11/-		17½	17½	6 7 3	14/3	10/6
Southern Areas	£1	15/-		10	7½	10 0 0	28/9	15/-
Strand Elec.	5/-	7/9	−6d	15	15	9 13 6	8/6	6/9
Sturtevant	5/-	22/6	−1/-	14·4†	15†	3 6 9†	31/3	22/6
Sun Elec.	£1	42/6	+5/-	20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	13/-	+3d	20	25	9 12 3	17/-	12/9
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	36/3		25	25	6 18 6	45/-	36/3
T.C. & M.	£1	26/3	−9d	8½	8½	6 9 6	34/-	26/-
Telephone Mfg.	5/-	7/-		10	10*	7 2 9	8/6	6/3
Thorn Elec.	5/-	17/6		15	15	4 5 9	22/6	16/-
Thornycroft	£1	35/-	−1/3	15	12½	7 2 9	49/9	35/-
Tube Investments	£1	56/3		22½	15*‡	5 6 9	70/6	54/9
Vactric	5/-	12/-	−1/-	15	17½*	7 5 9	15/-	11/6
Veritys	5/-	8/6	−6d	12½	12½	7 7 0	10/-	6/9
Walsall Conduits	4/-	12/3		70	20*	6 10 6	13/6	10/9
Ward & Goldstone	5/-	37/6		30	35	4 13 3	39/6	29/-
Watford	2/-	5/9		25	25	8 13 9	7/6	5/9
Westinghouse	£1	71/3	−1/3	18	18	5 1 0	100/-	71/3
West, Allen	5/-	12/-	+3d	15	15	6 5 0	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/9x.d.		8	8	7 7 3	23/6	20/3
British Elec. Traction: Def. Ord. "A"	5/-	17/6		22½	22½	6 8 6	20/-	15/6
Cable & Wireless: Ord.	5/-	10/-	−6d	10	10	5 0 0	11/3	9/6
4% Loan	100	91		4	4	4 8 0	92½	88
Calcutta Trams	£1	26/9		6†	7½†	5 12 3†	27/6	23/-
Cape Elec. Trams	£1	16/3		8	8	9 17 0	20/3	16/3
Marconi Marine	£1	31/-	−6d	10	10	6 9 0	34/-	31/-
Oriental Tel. Ord.	1/-	70/-		16	—	—	90/-	67/6
Telephone Rentals	5/-	10/9		12½	12½	5 16 3	11/9	9/9

REPORTS and DIVIDENDS

Tube Investments, Ltd., reports that the trading profits of subsidiaries for the year ended 31st July last were £14,615,922, as compared with £10,800,864 for the previous year. Depreciation absorbs £3,283,001 and taxation £6,286,704. The group net profit is £5,271,209 (against £4,428,523). General reserve receives £3,000,000 and it is proposed to pay a final dividend of 7½ per cent, making 13¾ per cent for the year on doubled capital. The distribution for the previous year on the smaller capital was 22½ per cent. The increase in the carry-forward is £299,807. The directors state that during the latter part of the year there was some falling-off of orders in certain sections of the group's activities. This trend has continued during the first quarter of the current year and has imposed a curtailment of activities in certain divisions.

Heenan Group, Ltd.—The preliminary financial statement for the year ended 1st September last shows group net profits, before taxation, of £505,900, as compared with £449,485 for 1954-55. Taxation requires £282,369 and the net balance is £223,509 (£217,009). A sum of £150,000 is placed to general reserve and the ordinary dividend for the year is maintained at 20 per cent by a final payment of 15 per cent. The balance carried forward in the accounts of the parent company and its subsidiaries is £73,231 (against £73,343 brought in).

At an extraordinary meeting to be held after the annual general meeting on 17th December, proposals will be submitted to increase the authorised capital to £1,600,000 and to capitalise £537,583 10s of existing reserves to be distributed to ordinary shareholders as bonus shares in the proportion of one 5s share for each 5s share held. Treasury consent to the issue has been obtained. The new shares will not rank for the final dividend for the past year.

Thos. W. Ward, Ltd.—The financial results for the year ended 30th June were given in our issue of 19th October. In the course of his statement, Mr. H. W. Secker (chairman) says that one of the group's more recent interests is in insulating materials. Good progress was made during the year under review by Dick's Asbestos & Insulating Co., Ltd., and a new factory was erected at a cost of £125,000. At the end of the financial year the factory was in an advanced stage and approximately 60 per cent had been occupied.

Holophane, Ltd.—The report and accounts for the year to 30th June last, now issued, confirm the figures given in our issue of 19th October. The report states that in the year under review the volume of business increased but further rises in costs of materials and operating expenses which were absorbed in an endeavour to stabilise prices, resulted in a reduction of the trading profit. The restrictions imposed at home and in overseas markets and the continuing increases in costs of materials and operating expenses make it difficult to foretell what the future conditions will be.

Reference is made to the fact that this is the diamond jubilee year of the company, and the report briefly reviews its history and recent and future lighting developments.

Elliott Brothers (London), Ltd., and **Associated Insulation Products, Ltd.,** have both declared interim dividends of 10 per cent. For 1955 Elliott Brothers paid an interim dividend of 5 per cent and a final dividend of 12½ per cent, and Associated Insulation an interim dividend of 8 per cent and a final payment of 12 per cent. It is reiterated that this is in accordance with the terms of the offer by Elliott Brothers for the shares of Associated Insulation which has now become unconditional and is designed solely to equalise the position between both companies. The increased interim dividends should not be taken as any indication of the rate of interim dividends to be declared in the future.

The Sun Electrical Co., Ltd., has announced a profit of £68,464 for 1955-56 as compared with £43,616 in the preceding year. The final dividend is maintained at 15 per cent but in addition a bonus of 5 per cent is to be paid, making 25 per cent (against 20 per cent) for the year. The general reserve receives £15,000 and the carry-forward is raised from £88,527 to £123,187.

Stothert & Pitt, Ltd.—The report and accounts for 1955-56 show that the profit of the parent company, after deducting all charges, including £332,712 for taxation, was £413,324 (against £403,981). The group profit was £381,039 (against £436,953). It is proposed to pay a final ordinary dividend of 12½ per cent, making 17½ per cent for the year.

The trading result of the main Australian subsidiary showed a small operating profit, but this was more than swallowed up by certain charges. The acquisition of the majority interest in the works in New South Wales has involved a substantial loss during the first full year's trading.

Switchgear & Cowans, Ltd.—Of the 200,000 5s shares issued to shareholders at 10s 6d per share, 190,003 have been taken up and the allotment of the balance has been scaled down.

Aerialite, Ltd., reports that after providing £157,193 for taxation, the group net profit for the year ended 31st May last is £145,472, as compared with £120,435 for 1954-55. It is proposed to pay a final ordinary dividend of 30 per cent, making 48 per cent for the year (against 45 per cent).

Johnson & Phillips, Ltd., have declared an interim ordinary dividend of 5 per cent (against 7½ per cent). The directors state that while orders received recently show a definite improvement, the financial results of trading for the first eight months, including overseas branches, are such that they do not consider any higher interim distribution would be justified at the present time.

W. & T. Avery, Ltd., have declared an interim dividend of 5 per cent (unchanged).

Ward & Goldstone, Ltd., are maintaining their interim dividend at 12½ per cent.

The Telephone Manufacturing Co., Ltd., has declared an interim dividend of 2½ per cent (unchanged).

New Companies

Rediweld-Oerlikon Electrodes, Ltd.—Registered 19th October. Capital £100,000. Manufacturers of electrical welding apparatus of all kinds and electrodes for electric blowpipe and other forms of welding and soldering, etc. Solicitors: Sydney Morse & Co., Alder House, Aldersgate Street, E.C.1.

Bishopsgate Electrical Co., Ltd.—Registered 5th November. Capital £1,000. I. Joseph is the first director. Regd. office, 26-27, Conduit Street, London, W.1.

Barflex, Ltd.—Registered 2nd November. Capital £1,500. Manufacturers of and dealers in electrical and heating equipment and control gear, etc. R. E. Verity, permanent director. Regd. office: 50, Ridgeway Avenue, East Barnet, Herts.

Bankruptcies

H. A. Mitchell, 14b, Woodgrange Avenue, Ealing Common, London, W.5, electrical heating engineer.—Receiving order made 26th October on a creditor's petition.

H. R. Jowett, formerly carrying on business with another as J. & L. Domestic Supplies Co., at 60, Church Road, Upper Norwood, London, S.E.19, as electrical appliance retailers.—Receiving order made 30th October on debtor's own petition.

W. A. C. Peacock, trading as W. A. C. Peacock & Son, at 49, Burkitt Street, King's Lynn, Norfolk, electrician.—Public examination 6th December at The Court House, London Road, King's Lynn.

S. L. Blythe, G. N. Bryan and **D. Mosley,** formerly trading together as Kirkstall Radio & Electrical Service at Kirkstall Lodge, Edwinstowe, Notts, as radio and electrical engineers (separate application of D. Mosley).—Application for discharge to be heard on 13th December at The Court House, St. Peter's Gate, Nottingham.

A. Le'N. Williamson, Sandringham Hotel, Hope Road, Shanklin, I. of W., hotel proprietor and electrical engineer.—Receiving order made 29th October on debtor's own petition.

Liquidations

Duralectrics, Ltd.—In voluntary liquidation. Meeting of members on 11th December, at 55, High Street, Doncaster, to receive an account of the winding-up by the liquidator, Mr. F. L. Moulding.

Plomer & Wilkinson, Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. C. E. M. Emmerson, 28, King Street, Cheapside, London, E.C.2, appointed 31st October. The creditors have also appointed a committee of inspection.

Youngs Electrical Services, Ltd.—Winding up voluntarily. Liquidator, Mr. I. Hiddleston, 70, Mutley Plain, Plymouth.

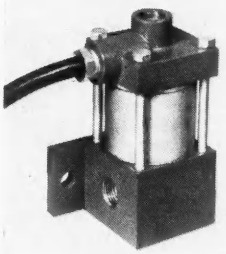
NEW ELECTRICAL EQUIPMENT

Test Lamp

A new test lamp has recently been introduced by JOHN DRUMMOND (ENGINEERS), LTD., Maryhill, Glasgow. A particular feature of the lamp is the simple interchangeability of the two types of prongs supplied (angled and straight). When not in use the prongs are housed and held firmly in the moulded rubber in the prods. The lamp has a "Perspex" cover, is housed entirely in moulded rubber and is practically indestructible. The price is £1 10s complete with 4ft of 6 mm h.v. cable and h.r.c. fuses in each prod.

Solenoid Operated Valves

Three new solenoid operated pilot valves are being made by the BALDWIN INSTRUMENT CO., LTD., Brooklands Works, Dartford, Kent. They are manufactured from the basic components of the well-established type V7/11 solenoid valve but have maximum working pressures of 250, 80 and 15 lb/sq in, the respective bores being $\frac{1}{16}$in, $\frac{1}{8}$in and $\frac{3}{16}$in. All units are suitable for use with compressed air, hydraulic oil and vacuum. The solenoids are d.c. operated, resulting in a complete absence of chatter, and suitable dropping resistors and rectifiers are available to convert the mains supply to the necessary condition. The speed of response is very high, and the units may be operated at frequencies in excess of 600 cycles per min for any desired period.

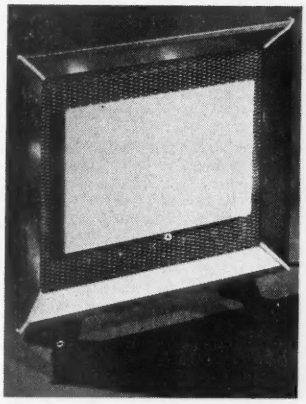


Baldwin solenoid operated valve

Convector Heater

The new "Masterpiece" convector heater just announced by the JACKSON ELECTRIC STOVE CO., LTD., Dallow Road, Luton, Beds., is designed in the form of a landscape shaped picture frame, finished in tessellated gold anodised aluminium. The "canvas" of the picture is of self-coloured expanded aluminium mesh, projected on the front of which is a centre panel. This panel may be obtained in either cream stoved enamel or matching finish identical to the picture frame. It can also be provided in a "biscuit" priming coat to which any colour can be applied to suit individual decorative schemes.

Two pigmy lamps situated behind the centre panel provide an attractive coloured glow to the aluminium mesh and frame. It is a 2 kW convector with thermostatic control (785) and by the location of the elements and design of the front baffle radiant heat is provided at foot level, while warm air is efficiently circulated in the room. Switch controlled models are also available (786) giving a selection of full or half heat. Models adapted for wall mounting, without feet, will be available later.

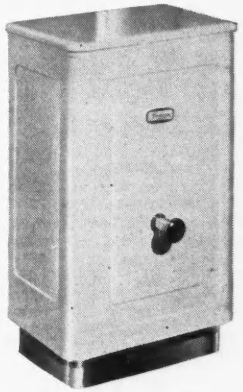


Jackson "Masterpiece" 2 kW convector

The prices of the thermostatically controlled models are:—785 (all gold finish) £10 10s plus £4 12s 2d purchase tax in the United Kingdom and 785C or P (cream or primer) £10 plus £4 7s 9d. The switch controlled models are priced at £9 10s plus £4 3s 4d (786) and £9 plus £3 19s (786C or P).

Wash Boiler

Another appliance introduced by the Jackson Electric Stove Co. is a rectangular wash boiler (No. 908), finished in white or cream heat-resisting enamel. Apart from a lightweight aluminium lid to the boiler, a table top cover can be obtained in turquoise blue, eau-de-nil, cream or white vitreous enamel. A plastic knurled knob on the chromium plated tap adds to the wash boiler's attractiveness. The rectangular shaped 10 gal interior takes 8 lb of linen and is sealed at the top forming a watertight rim, thus preventing any access of water to the electrical parts. The four clamped-on 750 W elements at the base are controlled by a d.p. rotary switch and the price is £12 12s. When the boiler is fitted with an automatic cut-out (909) the price is £14.



Jackson rectangular wash boiler

High Temperature Flux

Non-corrosive soft soldering fluxes based upon resin tend to carbonise at comparatively low temperatures so they can only be used with difficulty when insoldering commutators or in similar work where high operating temperatures necessitate the use of solder with a melting point higher than the normal tin-lead range. To overcome this FRY'S METAL FOUNDRIES, LTD., Tandem Works, Merton Abbey, London, S.W.19, have introduced "Alcho-re" soldering fluid, type S.64, which allows of an excess temperature of 50-100 deg C above the carbon point of orthodox resin fluxes. In this way soldering is completed without flux carbonisation and consequently the risk of de-wetting the dry joints is considerably reduced.

Tape Recorder

The release of a new all-British tape recorder, retailing at 39 gns, is announced by WALTER INSTRUMENTS, LTD., Garth Road, Morden, Surrey. The Walter 303, as it is known, has only two controls and is simple to operate. It has an output of 3 W, a frequency range of 40-10,000 c/s ±3 dB at a tape speed of $3\frac{3}{4}$ in/sec, and a signal-to-noise ratio better than −35 dB. The instrument is housed in an attractive two-colour case, and the price includes a crystal desk microphone and tape.

Walter 303 tape recorder

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 21st November from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

2640. National Research Development Corporation.—Multiplying arrangements for digital computing machines. 23rd January, 1953. (761968.)

8889. Revere Copper & Brass, Inc.—Electric furnaces. 7th April, 1952. (761970.)

22736. Muirhead & Co., Ltd.—Induction generators. 4th September, 1953. (762078.)

25381. Electric & Musical Industries, Ltd.—Electrical circuits for observing and storing potentials. 22nd September, 1953. (762079.)

25904. Yardney International Corporation.—Electric batteries. 15th October, 1952. (762080.)

26039. Electric & Musical Industries, Ltd.—Charging and/or discharging circuits for condensers. 21st September, 1953. (761853.)

26106. Standard Telephones & Cables, Ltd.—Circuit arrangement for a voltage comparing indicator tube. 17th October, 1952. (762081.)

1953

753. Mohr, R.—Lighter with electric ignition of the fuel. 9th January, 1953. (761973.)

9557. Radio Heaters, Ltd.—High frequency induction heating. 6th July, 1954. (Cognate application 11245, 23rd April, 1953.) (761760.)

10360. Siemens & Halske Akt.-Ges.—Wave-guide arrangement consisting of dielectric material. 15th April, 1953. (761659.)

10930. Mullard Radio Valve Co., Ltd.—Cathode-ray tubes. 20th April, 1954. (762088.)

12110. Standard Telephones & Cables, Ltd.—Microwave filters. 1st May, 1953. (761761.) 12111. Microwave transmission systems and impedance matching devices therefor. 1st May, 1953. (761762.) 12112. Microwave filters. 1st May, 1953. (761763.) 12113/4. Microwave transmission line. 1st May, 1953. (761764/5.)

15938. Standard Telephones & Cables, Ltd.—Electrical storage of coded information. 4th June, 1954. (762094.)

16192. Cole, Ltd., E. K., and Coppin, K. J.—Remote control arrangements. 13th September, 1954. (761978.)

17972. Compagnie Générale de Télégraphie sans Fil.—Delay lines for microwave tubes. 29th June, 1953. (761768.)

20054. British Thomson-Houston Co., Ltd.—On-load tap-changing circuits. 20th July, 1954. (761983.)

21226. Meccano, Ltd.—Electrical circuit current limiting devices. 5th July, 1954. (761661.)

21531. Metropolitan-Vickers Electrical Co., Ltd.—Joints between metal and dielectric materials. 4th August, 1954. (761662.)

22496. Standard Telephones & Cables, Ltd.—Wideband microwave attenuator. 14th August, 1953. (761869.)

23589. General Electric Co., Ltd., and Ferguson, H. M.—Refractor members for lighting fittings. 25th November, 1954. (761871.)

25538. Siemens & Halske Akt.-Ges.—Switching devices for supervising the readiness to receive condition of teleprinter subscriber stations. 15th September, 1953. (761873.)

25935. Gould, J. E.—Focusing magnet systems for cathode-ray tubes. 18th August, 1954. (761663.)

26689. United Kingdom Atomic Energy Authority.—Valve oscillator circuit arrangements. 22nd December, 1954. (761773.)

28268. Standard Telephones & Cables, Ltd.—Travelling wave tubes. 14th October, 1953. (762106.) 28269. Electron guns. 14th October, 1953. (762107.)

28785. Aktiebolaget Tudor.—Battery electrodes. 19th October, 1953. (762108.)

30781. English Electric Co., Ltd.—Electrical induction relays. 5th November, 1954. (761993.)

31595. Standard Telephones & Cables, Ltd.—Microwave filters. 13th November, 1953. (761778.)

31877. United Kingdom Atomic Energy Authority.—Digital computing apparatus. 17th November, 1954. (761878.)

32230. Standard Telephones & Cables, Ltd.—Microwave transducers for coupling microwave energy between waveguides. 20th November, 1953. (761780.) 32231. Microwave transmission lines. 20th November, 1953. (761781.)

33485. British Insulated Callender's Cables, Ltd.—Variable resistors. 1st December, 1954. (762112.)

34237. General Electric Co., Ltd., Dewar, G., and Harrison, W. J. D.—Contact spring assemblies for electro-magnetic relays. 9th March, 1955. (761998.)

36356. British Thomson-Houston Co., Ltd.—Electrical measuring apparatus. 14th December, 1954. (761785.)

36374. General Electric Co., Ltd., and Miller, J. S.—Manufacture of cold-cathode electric discharge devices. 31st December, 1954. (Cognate application 17243, 11th June, 1954.) (761882.)

1954

590. Standard Telephones & Cables, Ltd.—Microwave tuning network. 8th January, 1954. (761787.)

881. Soc. d'Eléctronique et d'Automatisme.—Analogue-to-digital converters. 12th January, 1954. (761884.)

976. Heron, A. G.—Electric cable termination. 5th January, 1955. (Cognate application 17886, 18th June, 1954.) (761885.)

980. Westinghouse Brake & Signal Co., Ltd., and Lockett, L. J.—Dry plate rectifiers. 15th December, 1954. (761789.)

1026. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for producing high voltage d.c. from a.c. sources. 13th January, 1955. (761886.)

2746. Standard Telephones & Cables, Ltd.—Microwave power splitting junctions. 29th January, 1954. (761790.)

2961. Siegel, D. T.—Terminal lugs of electrical components. 1st February, 1954. (761673.)

3704. Marconi's Wireless Telegraph Co., Ltd., and Buckingham, J.—Non-linear electrical circuit arrangements. 13th January, 1955. (761675.)

3803. General Electric Co.—Electric capacitor-discharge ignition systems. 9th February, 1954. (762119.)

4403. Singleton, S. A.—Small electric air pumps. 15th February, 1955. (761793.)

5642. Electric Furnace Products Co., Ltd.—Electrolytic cell for electrowinning manganese. 26th February, 1954. (761794.)

6045. Westinghouse Electric International Co.—Insulating coatings for magnetic sheet material and methods for producing such coatings. 2nd March, 1954. (761678.)

6789. Loewe Opta Akt.-Ges.—Electrode system for electron-beam valves, in particular for television picture tubes. 9th March, 1954. (762128.)

6914. General Electric Co., Ltd., and James, E. G.—Manufacture of semi-conductor devices. 7th March, 1955. (761795.)

7977. Sassi, U.—Machine for automatically assembling laminated iron cores for transformers and the like. 18th March, 1954. (762132.)

8703. Telefunken Ges.—Circuit arrangements for synchronising oscillation generators. 25th March, 1954. (761900.)

8754. Philips Electrical Industries, Ltd.—Fusion welding. 25th March, 1954. (761680.)

9145. Electric Construction Co., Ltd.—Electrical generating equipment. 16th May, 1955. (762014.)

9617. British Thomson-Houston Co., Ltd.—Electric ignition systems. 23rd March, 1955. (762015.)

9686. Wayne Kerr Laboratories, Ltd., and Calvert, R.—Measurement of the electrical conductance of liquids. 4th April, 1955. (761903.)

9751. Mullard Radio Valve Co., Ltd.—Cathodes for electric-discharge tubes. 16th February, 1955. (761684.)

9900. Mullard Radio Valve Co., Ltd.—Electric oscillator circuits employing transistors. 7th February, 1955. (761802.)

11447. Westinghouse Electric International Co.—Insulated coils and windings for electrical machines. 21st April, 1954. (761806.)

11814. General Electric Co., Ltd., Anderson, S., and Cates, J.—Circuit arrangements for operating low pressure electric-discharge lamps. 21st April, 1955. (761688.)

12113. Chloride Electrical Storage Co., Ltd.—Electrical rectifying means. 21st April, 1955. (761907.)

12376. Hughes Aircraft Co.—Electronic storage tube. 28th April, 1954. (762137.)

14112. Compagnie Générale de Télégraphie sans Fil.—Electron tubes of the crossed-fields type. 13th May, 1954. (762023.)

14862. Yardney International Corporation.—Electrode assemblies for electric batteries. 20th May, 1954. (762145.)

16328. Radio Corporation of America.—Beam convergence arrangement for a plurality of electron beams in a tri-colour kinescope. 2nd June, 1954. (761814.)

16479. Metropolitan-Vickers Electrical Co., Ltd.—Electric winding devices particularly for use with switchgear. 25th May, 1955. (762027.)

16489. Wipac Development, Ltd.—Electric switches and contact arrangements therefor. 6th May, 1955. (761701.)

16858. Kabushiki Kaisha, Hitachi Seisakusho, Hitachi, Ltd.—Electric transformers comprising electrostatic shielding means. 8th June, 1954. (761917.)

16909. Osnabrücker Kupfer- und Drahtwerk.—Process and arrangement for the production of cables and conductors having a corrugated sheathing. 9th June, 1954. (762029.)

18878. Davidsen, G. B.—Electric supply circuit for the operation of X-ray tubes. 28th June, 1954. (761705.)

19723. English Electric Co., Ltd.—Apparatus for the control of electric circuit-breakers. 1st July, 1955. (761923.)

20073. Radio Corporation of America.—Self-powered semi-conductive devices. 8th July, 1954. (Addition to 761404.) (761926.)

20435. Bogue Electric Manufacturing Co.—Magnetic speed regulators. 13th July, 1954. (762042.)

22898. Westinghouse Air Brake Co.—Methods of manufacturing selenium rectifier cells. 6th August, 1954. (761934.)

23176/7. Signal-Stat Corporation.—Snap-action electric switches. 10th August, 1954. (762045/6.)

25448. Automatic Telephone & Electric Co., Ltd.—Insulated electric wires. 29th August, 1955. (761943.)

27537. General Electric Co.—Frequency discriminators. 23rd September, 1954. (761826.)

28907. Hays Corporation.—Electrical systems for remote transmission of mechanical movements. 7th October, 1954. (761950.)

34736. General Electric Co.—Electronic magnetic recording systems. 30th November, 1954. (762057.)

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 19th November

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "Modern Methods of Recording Reproduction and Sound," by Dr. G. F. Dutton.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Supply Group. "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie (to be read by A. A. Fulton).

CHESTER.—Town Hall, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

IPSWICH.—Electric House, 7.15 p.m. Ipswich & District Electrical Association. "The History of Quality Control and Lamp Making," by Dr. B. P. Dudding.

NEWCASTLE-UPON-TYNE.—King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. Informal lecture on "The Television Studio as seen by the Producer," by Alvin Rakoff.

STONE.—Duncan Hall, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "The Generation and Synthesis of Music by Electrical Means," by A. Douglas.

Tuesday, 20th November

CAMBRIDGE. — Cambridgeshire Technical College, Collier Road, 6.30 p.m. I.E.E. East Anglian Sub-Centre. Discussion on "Technical Education," opened by Prof. E. B. Moullin and J. Wooding. (Joint meeting with the Eastern Branch of the Institution of Mechanical Engineers.)

CHELMSFORD. — Public Library, 7 p.m. I.E.E. London Graduate & Student Section, district meeting. "Manufacture of Electric Cables," by J. D. Navey.

CHELTENHAM.—Fleece Hotel, High Street, 6.30 p.m. I.E.S. Gloucester & Cheltenham Centre. "Road Vehicle Lighting," by K. J. Jones.

COVENTRY.—Electricity Sports & Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. "Flameproof Electrical Equipment," by R. Court.

GLASGOW.—Grosvenor Restaurant, Gordon Street, 6 p.m. I.E.E. Scottish Centre. Dinner-dance.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilisation Group. Discussion on "The Influence of Maintenance Requirements on the Design of Industrial Electrical Equipment," opened by H. C. Fox.

LIVERPOOL.—At the Corporation Passenger Transport Dept., 24, Hatton Garden, 6 p.m. I.E.S. Liverpool Centre. "Architects' Views," by J. G. R. Sheridan.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement & Control Section. Discussion on "Data Processing Equipment for Experimental Work: a Review of Techniques and Methods," opened by Dr. M. V. Wilkes.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurement & Control Group. Discussion on "Is the Electrical Equipment of the Modern Motor Vehicle Sufficiently Reliable?" opened by Dr. E. A. Watson.

Engineers' Club, Albert Square, 6.30 p.m. Institute of Petroleum. "Diesel-Electric Traction," by D. C. H. Matthews.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Graduate & Student Section. "Hydrogen Cooled Alternators," by J. A. Pownall.

Wednesday, 21st November

BIRMINGHAM.—James Watt Institute, Great Charles Street, 7 p.m. Institution of Production Engineers, Birmingham Section. "The Use of Isotopes in Industry," by Dr. H. Seligman.

CHELTENHAM. — North Gloucestershire Technical College, 7 p.m. Society of Instrument Technology, Cheltenham Section. "Problems in the Manufacture of Semi-Conductors," by F. C. Carpenter.

FARNBOROUGH.—R.A.E. Technical College, 7 p.m. I.E.E. Southern Graduates' & Students' Section. "Properties and Applications of Some Recent Semi-Conductor Devices," by J. F. Winterbottom.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. Discussion on "Aluminium Conductor Cables," opened by G. F. Peirson.

Waterloo Bridge House, S.E.1, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "Some Problems Arising in the Technical Education of P.O. Engineering Staff," by F. C. Mead.

At the Institution of Electrical Engineers, Savoy Place, W.C.2, 2.15 p.m. Public meeting organised by the Electrical Association for Women. "Planning for Light."

A.S.E.E. South West London Branch. Visit to Television Studios, Lime Grove.

NOTTINGHAM. — E.M.E.B. Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. "Roller Bearings," by C. S. Clarke.

PRESTON.—19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "School Lighting, Part I," by G. S. Pester and J. Blackie.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

SOUTHAMPTON. — A.S.E.E. Southampton Branch. Visit to Police Headquarters, Civic Centre, at 7.30 p.m.

WALTON-ON-THAMES. — I.E.E. London Graduate & Student Section. Visit to Hackbridge & Hewittic Co., Ltd., at 2.30 p.m.

Wednesday, 21st November, and Thursday, 22nd November

LONDON.—4, Grosvenor Gardens, S.W.1. Iron and Steel Institute. Autumn general meeting.

Thursday, 22nd November

BIRMINGHAM.—Exchange & Engineering Centre, Stephenson Place, 7 p.m. Institute of Marine Engineers, West Midlands Section. "Nuclear Engineering," by J. A. Kendall.

CATTERICK.—Headquarters Mess, School of Signals, Catterick Camp, 6.15 p.m. I.E.E. North Midland Centre, district meeting. Two papers on "Communication by Tropospheric and Ionospheric Scatter," by Dr. J. A. Saxton and W. J. Bray.

KETTERING.—George Hotel, 6.30 p.m. I.E.E. East Midland Centre. "Ultrasonics in Industry," by C. F. Brocklesby.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "The Presentation and Demonstration of the Theory of Semi-Conductors to Students of Electrical Engineering," opened by P. Godfrey.

Savoy Hotel, W.C.2. Gauge & Tool Makers' Association. Annual general meeting, preceded by informal luncheon.

Thursday, 22nd November, and Friday, 23rd November

LONDON.—Central Hall, S.W.1, 10 a.m. British Nuclear Energy Conference. "Calder Hall Symposium."

Friday, 23rd November

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "Modern Applications of Plastics to Lighting Fittings," by P. H. Collins.

CARDIFF. — St. Mellons County Club. I.E.S. Cardiff Centre. Annual dinner-dance.

CLACTON-ON-SEA.—Royal Hotel. Ipswich & District Electrical Association. Ladies' night.

EDINBURGH.—Heriot Watt College, 7 p.m. Institute of Fuel, Scottish Section. "The Use of Local Energy Resources in Underdeveloped Areas," by E. W. Golding.

The University, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Information Theory," by L. C. Stenning, Dr. P. Jones and P. Holroyd.

GLASGOW. — Georgic Restaurant, Union Street, 12.30 p.m. I.E.S. Glasgow Centre. Luncheon meeting.

HATFIELD.—Green Tree Hotel, 7 for 7.30 p.m. Institution of Works Managers, Doncaster Branch. Anunal dinner and dance.

LEICESTER. — Coronation Hotel. I.E.S. Leicester Centre. Social evening.

LONDON.—Connaught Rooms, W.C.2, 5.30 for 6 p.m. Electrical Power Engineers' Association. Annual dinner.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Computers in Industry," by B. Pollard.

PETERBOROUGH. — White Lion Hotel, Church Street. Incorporated Plant Engineers, Peterborough Branch. Annual dinner.

STONE.—Crown Hotel, 8.30 p.m. I.E.E. North Staffordshire Sub-Centre. Annual dance.

WEMBLEY PARK.—Century Hotel. A.S.E.E. North West London Branch. Annual dinner and dance.

Saturday, 24th November

BLACKPOOL.—Cliffs Hotel, 6.15 for 6.45 p.m. I.E.E. North Lancashire Sub-Centre. Dinner-dance.

LONDON.—Battersea Polytechnic, S.W.11, 9 a.m. Electrical Association for Women. One-day conference on "The Teaching of Electrical Housecraft."

Duke of York's Headquarters, Chelsea, 7 p.m. Royal Engineers' Association. Centenary celebration. London Sapper Reunion.

MANCHESTER. — Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. Ladies' evening.

SALISBURY.—S.E.B., 6.30 p.m. I.E.E. Southern Centre. Informal discussion on "Is the Electrical Equipment of the Modern Motor Vehicle Sufficiently Reliable?" opened by Dr. E. A. Watson.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 24th November:—

MUTE. No. B734,425. Class 7. Electric motors for incorporation in heating and ventilating apparatus and installations.—Flexaire, Ltd., 108, Victoria Street, Westminster, London, S.W.1.

No. 750,192 (design). Class 9. Radio receiving sets and parts; television, telephonic, radio telephonic and radio telegraphic apparatus; and microphones, loudspeakers, electrical pick-ups, vacuum tubes, electric cells, batteries and condensers.—Shirasuna Denki Kabushiki-Kaisha, Japan. Address for service, c/o J. E. Evans-Jackson & Co., 49, Albert Hall Mansions, Kensington Gore, London, S.W.7.

FOIL-O-MATIC. No. 754,642. Class 9. Insulated metal foil for use as an electrical conducting material.—R. C. Malby, 1, Queens Park Road, Brighton.

REGULAC. No. 755,631. Class 9. Variable voltage transformers, automatic voltage regulators and voltage stabilisers.—Claude Lyons, Ltd., 76, Old Hall Street, Liverpool, 3.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—City of Melbourne. 3rd December. Oil switch units. (E.S.B. 28089/56. Ten/22493.)*

Banbridge.—28th November. Electrical installation in boys' and girls' intermediate school. Varming & Mulcahy, consulting engineers, 37, Malone Road, Belfast.

Belgium. — Ministère de la Défense Nationale. 22nd November. Cables and insulating materials for motor vehicles. (E.S.B. 28249/56. Ten/22523.)*

Burma.—Union Purchase Board. 29th November. Cables. (E.S.B. 28191/56. Ten/22501.)*

Crosby.—Borough Council. 28th November. Group "A" street lighting. Surveyor, Town Hall, Waterloo, Liverpool, 22.

Fife.—County Council. 17th December. Street lighting equipment. (See this issue.)

Guatemala.—Ministry of Communications and Public Works. 27th November. Electrical equipment for a street lighting scheme. (E.S.B. 27464/56. Ten/22436.)*

India.—Government of Mysore. 30th November. Two 2,000 kVA transformers. (E.S.B. 28031/56. Ten/22456.)*

Madhya Pradesh Electricity Board. 17th December. Power transformers for Khaperkheda and Paras power stations. (E.S.B. 28056/56. Ten/22492.)*

Northumberland.—U.D.C. Electrical work in 32 houses at Bull Field. Council surveyor.

Pakistan.—Posts and Telegraphs Department. 1st December. Switchboard cable. (E.S.B. 28125/56. Ten/22459.)*

Rhodesia & Nyasaland.—Bulawayo City Council. 5th December. Cable joint boxes. (E.S.B. 28352/56. Ten/22543.)* Overhead line materials. (E.S.B. 28351/56. Ten/22558.)*

Scarisbrick.—West Lancs R.D.C. 26th November. Street lighting equipment. (See this issue.)

South Africa.—Union Tender and Supplies Board, Pretoria. 29th November. P.v.c. wire. (E.S.B. 28345/56. Ten/22532.)*

United States.—Bureau of Reclamation. 27th November. Distribution boards and battery chargers. (E.S.B. 27809/56. Ten/22466.)* Two power transformers. (E.S.B. 27808/56. Ten/22481.)*

Bureau of Reclamation, Denver. 4th December. Six switchboard panels and two telemeter transmitters. (E.S.B. 28401/56. Ten/22563.)

West Hartlepool.—Corporation. 3rd December. Electrical installation in eight shops and nine maisonnettes to be built in Wynyard Road. Borough architect, Municipal Buildings.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aldridge.—Flats and bungalows (32), Pelsall Wood estate; James Mason, U.D.C. surveyor, The Poplars, 9, Leighswood Road, Aldridge, near Walsall.

Ashby.—Covered market and café in High Street; borough architect, Scunthorpe.

Blackpool.—Flats (60), Grange Park estate; borough surveyor.

Boldon.—Houses (26) on the Boldon housing site; J. T. Edmondson, U.D.C. surveyor, East Boldon, Co. Durham.

Chelmsford.—Houses (235), in various parishes; R.D.C. surveyor, Council Offices, New London Road.

Chesterfield.—Electrical installation at Abercrombie Annexe of Royal Hospital to be overhauled; regional engineer, Chesterfield Hospital Management Committee.

Cockermouth.—Houses (94) in various parishes; surveyor, Rural Council Offices, Holmewood, Cockermouth, Cumberland.

Croydon.—Shops, offices and basement car park, Scarbrook Road/Surrey Street site; Myton, Ltd., Park Street, London, W.1.

Dagenham.—Dwellings (86), Marks Gate estate; S. R. Bryett, builder, Church Elm Lane.

Darlington.—Houses (500) on the Branksome estate and (300) at Firth Moor, and new municipal building; E. A. Tornbohm, borough architect.

Dewsbury.—Extensions to Dewsbury and Batley Technical and Art College (£200,000); clerk to Governors, Halifax Road.

Dover.—Houses (87), on site west of St. Patrick's Road; borough surveyor, Brook House.

East Sussex.—Imberhorne County Secondary School, East Grinstead; phase 1 of Newhaven County Secondary School; county architect, County Hall, Lewes.

Eccles.—Flats (32), Barton Lane and Trafford Road; Frank Bradley, architect, 4, Wood Street, Bolton.

Gateshead.—New premises, Hawks Road, for J. Brewster and Co. (Transport Engineers), Ltd.; J. Moffitt, architect, Cheviot View, Ponteland, Northumberland.

Heywood.—New civic hall proposed; A. Middleton, borough surveyor, Municipal Buildings, Longford Street.

Holland.—Science and assembly hall/gymnasium blocks at Boston Grammar School; L. Barlow, county architect, County Hall, Boston.

Ipswich.—Houses (44), Chantry estate; Macro, Ltd., builders, Pine Avenue.

Jarrow.—Houses (1,300) in the overspill area; H. W. T. Perkins, borough engineer.

Kingswood.—Houses (410) at Kingswood and Hanham; U.D.C. surveyor, Council Offices, High Street, Kingswood, Bristol.

Leicester.—Old people's bungalows (59) on Eyres Monsell estate; city architect.

London.—Office block, Falcon Court, Fleet Street; James Webb & Son, Ltd., builders, 326, St. John Street, E.C.1.

Flats (62), Brixton Road and Angel Road, Lambeth; Arthur W. Kenyon & Partners, architects, 15, Adeline Place, W.C.1.

Dwellings (618), Regent's Park estate, St. Pancras; Armstrong & MacManus, architects, 28, Gloucester Place, W.1.

Mermaid Theatre, restaurant, etc., Puddle Dock site, Blackfriars; E. L. W. Davies, architect, 3, Gower Street, W.1.

Rebuilding Minet Library, Lambeth; F. Batterbury, borough engineer, Town Hall, Brixton Hill, S.W.2.

Flats (242), Galway Street area, Finsbury; borough engineer, Finsbury Town Hall, Rosebery Avenue, E.C.1.

Church, Sydenham Road; Walters & Kerr-Bate, architects, 14, Gray's Inn Square, W.C.1.

Margate.—Factory, Ramsgate Road, Westwood; G. A. Harvey & Co. (London), Ltd., Woolwich Road, London, S.E.7.

Mill Hill.—Church, offices and printing department, Bittacy Hill, N.W.7; International Bible Students' Association, 34, Craven Terrace, Paddington, London, W.2.

Middlesbrough.—Bakery on two-acre site, Longlands Road/Cargo Fleet area; S. Hill and Son, Ltd., Longlands Road and Linthorpe Road.

Houses (51) and police houses (10), Pallister estate; borough engineer.

Midhurst.—Houses (92), Nappers Wood area, Fernhurst; surveyor, Rural Council Offices, Midhurst, Sussex.

Newcastle-on-Tyne.—Homes for infirm on Sections "C" and "E," Montagu estate; flats and maisonnettes (72), Group 22, Kenton North estate and primary school, Carsdale Road; city architect, 18, Cloth Market.

Northampton.—Extensions (£300,000), at General Hospital; Robert Marriott, Ltd., builders, Higham Road, Rushden.

North Shields.—Offices, warehouse and other buildings for bacon curing, Norham Road; Hadrian Supplies, Ltd., Station Road, Wallsend.

Northern Ireland.—Houses and flats (218), Antiville site, Larne; T. Davison, housing officer, 46, Main Street.

Factory, Coleraine; Chemstrand, Ltd., Monsanto House, Victoria Street, London, S.W.1.

Northfleet.—Houses (133), Istead Rise; S. B. Budge & Co., builders, 478, Barking Road, London, E.13.

Oundle.—Houses (54) in Glapthorne Road; U.D.C. surveyor, Oundle, Northants.

Portsmouth.—Factory on the Havant Street/College Street site; Gieves, Ltd., naval outfitters, 22, The Hard.

Rogerstone.—Office building for Northern Aluminium Co., Ltd.; Frank Scarlett, architect, 18, Mansfield Street, London, W.1.

Romford.—Flats (84), Dagenham Road; Selleck Nicholls & Co., Ltd., builders, East Hill, St. Austell.

South Shields.—Three-storey flats (240), Raglan Street; borough engineer.

Stamford.—Houses (44) in West Street for the T.C.; Kelham & Hart, Broad Street, Stamford, Lincs.

Stretford.—Two-storey workshop premises; Norbury Printers, Ltd., lithographic printers, Elsinore Road, Trafford Park, 16.

Sunderland.—Three-storey flats and four-storey maisonnettes, Lawrence Street site; borough architect.

Taplow (Bucks).—Proposed rebuilding of Skindles Hotel, providing for five-storey hotel and seven blocks of flats; Bowden, Son & Partners, architects, 3, Adelaide Terrace, London, N.1.

Trowbridge.—Houses (127), Studley Green estate, for U.D.C.; Holdoway & Sons, Ltd., building contractors, Station Road, Westbury, Wilts.

Tynemouth.—Houses (22), Waterville Road; borough surveyor.

Wallsend.—Three-storey flats (54), Willington West Farm; J. H. James, Archer Street, Willington Quay.

Warrington.—Development of site in Winwick Road; Lansing Bagnall, Ltd., electric vehicle manufacturers, Station Approach, London, S.W.14.

West Hartlepool.—Houses (102) for the T.C.; Tarslag, Ltd., builders, Bowesfield Lane, Stockton-on-Tees.

Weston-super-Mare.—Church, Bourneville, for Bath and Wells Diocesan Board of Finance; Vallis & Bird, architects, 6, North Parade, Frome, Somerset.

Woodcote.—Primary school; Walden & Son, Ltd., builders, Empstead Works, Henley-on-Thames.

Wrexham.—R.C. secondary modern school; P. & M. White, architects, 46, Granville House, Arundel Street, London, W.C.2.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

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